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THINKING IN ELEMENTARY SCHOOL CHILDREN.
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THE DEVELOPMENT OF THOUGHT PROCESSES UNDER OPTIMUM TRAINING CONDITIONS WAS STUDIED. OPTIMUM WAS DEFINED TO INCLUDE (1) A CURRICULUM FOR THE DEVELOPMENT OF THOUGHT, (2) TEACHING STRATEGIES FOCUSED DIRECTLY ON MASTERY OF NECESSARY COGNITIVE SKILLS, AND (3) A SUFFICIENT TIME SPAN TO PERMIT A DEVELOPMENTAL TRAINING SEQUENCE. CHILDREN FROM 20 ELEMENTARY SCHOOL CLASSES (GRADES 2 THROUGH 6) PARTICIPATED. PARTICIPATING TEACHERS RECEIVED SPECIAL TRAINING TO FACILITATE LEARNING OF COGNITIVE SKILLS (CATEGORIZATION, INTERPRETATION, AND APPLICATION OF PRINCIPLES). METHODOLOGICAL TOOLS AND INSTRUMENTS WERE DEVELOPED AND ADMINISTERED WITH THE SOCIAL STUDIES INFERENCE TEST. CORRELATIONS BETWEEN CRITERION TEST SCORES, INTELLIGENCE, CHRONOLOGICAL AGE, MENTAL AGE, AND READING ACHIEVEMENT WERE REPORTED. QUALITY OF THE TEACHING STRATEGY WAS THE MOST SIGNIFICANT SINGLE FACTOR INFLUENCING COGNITIVE PERFORMANCE. (WN)

ED003285

THINKING IN ELEMENTARY SCHOOL CHILDREN

SAN FRANCISCO STATE COLLEGE

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Cooperative Research Project No. 1574

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PREFACE

Several theoretical considerations dictated the major tasks and the methodology of this study. The chief focus was to examine the effect of training on the development of thinking. Previous studies of development of thinking have tended to treat the emergence of new thought forms as a spontaneous developmental phenomenon. While the influence of experience is admitted, the possibility of conscious training has not been considered. Educators, on the other hand, have long assumed that thinking involves skills which can be developed by conscious guidance and stimulation, provided it is possible to devise teaching strategies which are appropriate for this purpose. The chief problem, therefore, is to design learning experiences which stimulate the development of cognitive structures without depriving students of autonomy and capacity for self-activity in generating new forms of conceptualization and of thinking. This requires a major revision in the concept of the role of teaching.

Another task of the study was to apply certain theoretical concepts about cognitive development generated in experimental laboratory settings to the more complex classroom situation and to test their usefulness.

The gap between the findings of theoretical research on learning in general and on cognition in particular is wide. Research in the classroom setting should help narrow this gap and make available findings from theoretical work which will aid the improvement of instruction. This particular study was guided, for example, by several concepts in Piaget's theory of cognitive development. Among these were the ideas that conceptual schema cannot be given to children but inevitably must be constructed by the learner, the concepts of assimilation and accommodation as principal mechanisms of transition from one level of intellectual operations to another, and the idea of a hierarchical order of conceptual schemes and hence also of a sequential developmental order in mastering them.

These concepts were already imbedded in the social studies curriculum used by the classrooms in the study. The additional task of the study was to translate the requirements of the development of thought into teaching strategies, to train the teachers, and then to examine the effect of these strategies on thinking.

This study of thinking in elementary school children was exploratory in many respects. First, there was an attempt to develop a conceptual basis for analyzing thinking in a classroom setting. Second, the study was conducted in the context of social studies, for which there was no adequate model. Available models were confined to studies conducted largely in the context of mathematics and science. Third, it was necessary to develop the research tools, while, at the same time, using these tools to secure data and to analyze them. These were rather ambitious tasks to complete in the eighteen months' duration of the study and they naturally were too complex to permit perfection either in the research tools used or in the definitiveness of findings. Therefore, the reader is cautioned to consider the data reported as exploratory rather than definitive findings which, nevertheless, may open up possibilities for creating a framework for future studies of cognition in the classroom and for bridging the gap between the applied and the "pure" research approaches to studying thinking.

The study was also animated by a hope of establishing a two-way traffic between learning theory and classroom learning. So far there has been considerable emphasis on the problem of applying the findings from laboratory studies of learning to instruction in the classroom. It is conceivable that a reverse direction in the flow of ideas would be useful also. It is possible that the studies of classroom experience may contribute to the focusing of questions for experimental research and possibly even to research methodology. Such a two-way traffic may also solve one of the current dilemmas in communication about learning. As has been pointed out, a way is needed to prevent the difficulty of 'psychologists talking only to psychologists' and 'educators talking only to educators'. A beginning must be made for a more adequate two-way communication between psychologists and educational practitioners. The naiveté of psychologists about educational processes is probably as much of a handicap in utilizing research on learning for improving teaching as is the naiveté of educators about the psychology of learning. It is possible that some of this naiveté on both sides of the intellectual continental divide will be dispelled if the problems of cognitive development are tackled simultaneously in the classroom and the laboratory. A two-way traffic in problems, hypotheses, and findings from the applied to the theoretical, and vice versa, may actually facilitate the development of both the theory of learning and the theory of instruction.

As far as methodology is concerned the study owes much to its predecessors who opened the way to studying teaching and learning in the classroom. Among these are Mary Jane Aschner, John Gallagher, Marie Hughes, and B.O. Smith.

Several consultants helped sharpen the ideas and techniques. Among these were Ned Flanders, Irving Sigel, and J. Richard Suchman. We owe much to Fred McDonald for his help in checking the design of data analysis

and the statistical format for processing data, and to Philip J. Stone for devising a computer program for the study.

The research staff is especially indebted to the supervisors of the Contra Costa County Schools, Mary Durkin, Alice Duval, and Alice McMasters, and the administrators of the schools who helped in the training of the teachers and who harnessed their energies to provide a cooperative setting for the study. Special appreciation is due to Mary Durkin, who served as a part-time staff member responsible for the administrative arrangement, public relations, and the taping of classroom discussions, and who supplied both seemingly inexhaustible energy and devotion to assembling the data and provided many an illuminating insight into the dynamics of classroom interaction and the ways of teaching.

We are deeply indebted to the teachers of the twenty classrooms who generously permitted us to enter their classrooms and study their children.

Finally, the personal appreciation of the research staff is extended to Marjorie Posner and Memory Goméz, who spent many exhausting hours in performing expertly the secretarial duties.

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CHAPTER I

STUDIES OF THINKING

The development of thinking has figured as an important objective of education for a long time. Yet the implementation of this objective in curriculum and teaching has been sporadic and ineffective, for a variety of reasons.

First, thinking has been treated as a global process. Consequently, the problem of defining thinking is still before us, as is the need to identify its specific behavioral operations, especially in terms which can help in the planning of effective teaching strategies. In a jungle of definitions, thinking has meant anything that goes on in the head, from daydreaming to creating a concept of relativity. Neither has knowledge about the development of thinking been adequate. The chief contribution to understanding the developmental sequence in the growth of cognitive skills has come from Piaget and his followers, but these studies have received scant attention.

The implementation of thinking as a distinct educational objective has, in addition, been handicapped by several questionable assumptions about how students learn to think. For example, it is often assumed that assimilation of the products of disciplined thinking produces disciplined thinking, or that reflective thinking cannot take place until a sufficient body of factual information has been accumulated.

An equally misleading assumption is that thought is an automatic by-product of studying certain subjects. Some subjects are supposed to have this power independently of how they are taught or learned. Inherently, memorizing mathematical formulae or the steps in mathematical processes is assumed to be better training than memorizing cake recipes, even though both may be learned in the same manner and call for the same mental process.

The combination of these factors has prevented the focusing on the central issue of assisted versus unassisted growth in thinking; that is, the problem of training and of developing teaching strategies designed to stimulate the development of cognitive skills. Curriculum is seldom organized to focus on active formation and use of abstract ideas. Classroom learning experiences are not usually designed to provide a cumulative sequence for the learning of cognitive skills which is at once psychologically sound and logically valid.

All this has contributed considerably to underachievement in the mastery of autonomous and disciplined thought processes. Current teaching-learning procedures tend to cultivate a passive mastery of ideas instead of their active discovery, a tendency to follow "recipes" in solving problems instead of analyzing problems and searching for generalizations with which to organize facts and plan an attack on problems (Buswell and Hersh, 1956; Suchman, 1962; Bartlett, 1958, p. 93).

AN HISTORICAL NOTE

Attention to thinking as a part of the educational process has had an interesting history in the past few decades. In the 1930's, concern for the development of critical thinking was at the heart of much of the work of the Eight Year Study, sponsored by the Progressive Education Association. The evaluation staff in the Eight Year Study spent years in identifying certain aspects of thought, in analyzing the processes involved in each, and in developing some highly diagnostic evaluation instruments to measure progress in mastering them. The objective of thinking was divided into three specific areas: the ability to infer generalizations from specific data; the ability to apply known principles in explaining new situations or predicting consequences; and the ability to do critical thinking _per se_ (Smith and Tyler, 1942; Taba, 1950). Several other studies of critical thinking were initiated but not brought to completion, such as the Cornell Study of Critical Thinking (Anderson, 1942; Anderson, Marcham and Dunn, 1944).

Earlier, Dewey (1933, pp. 107-115) had evolved a theoretical model for scientific inquiry, describing the steps in this inquiry as consisting of suggestion, intellectualization, hypothesizing, reasoning, and testing the hypothesis by action. In practice, this model was converted into sequential steps for problem solving. This model is still in use today, except that the sequence of steps has been mechanized instead of being checked and enlarged through empirical testing of its utility in a variety of contexts.

Work on the development of thinking began at this time also. Piaget started his studies of cognitive development over forty years ago. But until recently few people read him; partly because his descriptive observational method was uncongenial to the statistical approach to research which prevailed at the time; partly because his approach was epistemological, which was foreign to the experience of American psychologists; and partly because, in his effort to combine the logical and psychological approach to thinking, Piaget created an idiosyncratic terminology which was difficult to understand (Flavell, 1962).

Today there is a highly receptive climate for the study of cognitive processes which has resulted in a renewed interest in the earlier work. The concepts underlying the earlier tests of thinking developed by the evaluation staff are being re-explored (Ennis, 1962). Rather than being considered an esoteric and eccentric researcher, Piaget is now thought of as an author of a monumental theoretical edifice, and his conceptual model of thinking is employed in many current research studies, in experimental laboratories, and in classrooms. It is interesting to note that some of the findings from these recent studies bear a remarkable likeness to the results of the earlier thought and work. While the current research on thinking throws new light on the earlier assumptions, its results also confirm the earlier semi-intuitive conceptions.

THE NATURE OF THOUGHT

As yet, many questions about the nature of thought remain to be answered before even a gross theory can emerge regarding what thinking is and what its elements and characteristics are.

At present, a variety of partial models are being explored. Bruner (1963), for example, raises four questions regarding operations of thinking and intellectual growth:

1. What is the nature of the representation of the world, and how do these representations change with growth?

2. What is the scope of connectiveness of particular representations? Some representations take in great generic chunks of the world and permit ready redognition of the relations between things. Others are highly specific, event-bound, time-bound, and permit little transfer of knowledge

and skill from one situation to another. How does transferability come about?

3. How do we operate on these representations in order to predict or extrapolate and otherwise go beyond the information given? How does a transformation of the operations of the child into the operations of the adult take place?

4. Which of the kinds of cognitive operations that a person can perform depend on man's genetic code, and which of them depend upon instruments, appliances, forms, and other types of intellectual prosthetic devices or aids to skill that can be added?

A distinction is emerging between the problems connected with concept formation and those pertaining to strategies by which concepts are related to each other and by which they are otherwise transformed and operated upon.

These are important issues, because on their resolution depends how we conceive curriculum, instruction, and other means whereby we equip human beings for growth in cognitive functioning. We need to differentiate what comes about unassisted in cognitive functioning and where assistance and training are needed.

As yet, there are few studies of thinking that are concerned with processes and strategies of thought, and each seems to be using a different frame of reference based on different assumptions. In addition to a lack of a clearcut theoretical framework for differentiating the elements of thought and the relationships between these elements, confusion seems to prevail about the role of the psychological and logical aspects of thought. Piaget (1953) distinguishes the two. Peel (1960, p. 89) points out that thought can be studied both as a psychological phenomenon and as a logical system. "If the psychology of thought is concerned with how people think, the logic of thought can be considered as the model of actual thought." For example, concept formation involves certain psychological processes, such as discriminating the elements or properties of objects or events, but the kinds of discriminations that are made can be assessed in terms of their logical form, relevance, level of abstraction, and of their appropriateness to the logical Gestalt of the task of producing or discovering the concept in question.

As will be shown later, both are important in analyzing learning processes and in assessing the effectiveness of teaching strategies. Smith (1950) has pointed out the deficiencies in the concept of teaching caused by the failure of the psychologically oriented analysis of thinking to consider the logical operations which individuals do and must perform on the content of their experiences, and the validity of the products of these experiences. The usual classroom treatment of the problem solving process is an example of this failure to consider the logical validity of the resulting product. When the steps of problem solving are followed with little regard for the quality of the product, the process of fact finding may end in irrelevant, inadequate, or poorly interpreted data. Students often project problems to study which are not worth studying.

It is, of course, important to distinguish and to study the various types of thought processes such as differentiation, concept attainment, inference or generalizing, and the ways in which they come about. But it is equally important to apply logical criteria in describing the content of these processes. Concepts, generalizations and judgments, as products of thought, can be of different levels of abstraction and complexity. For example, one can group and classify information on different levels of generality. Inferences can be fairly close to that which is given, or make a leap.

There may also be, as Dienes (1959, p. 10) suggests, an inherent relationship between the process and the content:

> Apart from differences in individual emphasis ... we must consider the possibility that there are ways which are objectively better or more efficient for acquiring a given concept ... because of the inherent nature of the concepts in question. It has, in fact, been shown that certain concepts are just not amenable to learning by certain forms of mental organization; objective methods are now being developed by means of which such regions of optimum emphasis may be determined.

One factor in obtaining a match between processes of thought and their products may be found in the hierarchical nature of these products. It is conceivable, for example, that there are differences in the strategy of concept attainment, depending on the abstractness and complexity of the concepts involved.

STYLES OF THINKING

A canvas of recent research, both published and unpublished, reveals several types of approaches to the study of cognition in general, and of thought in particular. A number of studies are concerned with the styles of thinking and with the individual differences in these styles. Individuals presumably have a predilection toward one or the other way of selecting what they respond to in their environment and of organizing what they know and see. The genesis of these styles is still obscure, although an assumption is frequently made that it is related to personality factors.

The term "style" refers to a mode or modes of thought which an individual employs rather persistently in a variety of different cognitive tasks, such as selecting a basis for grouping objects, determining how to label what he sees and how to organize the various aspects of his environment. A variety of such styles have been identified. Bartlett and Rokeach, for example, speak of the closed and open systems of thought. The former is characterized by uniformity of the process and of the order of steps. Once the necessary amount of evidence has become available, the thinker is sooner or later compelled to take the route he takes. In contrast, the open system of thought breaks out of this mold (Bartlett, 1958; Rokeach, 1960).

This classification is very similar to the convergent and divergent thinking described by Guilford (1960). Convergent thinking is a mode of thinking which is directed toward finding a correct or a "right" answer by a predetermined method. Divergent thinking is oriented toward the novel and the unusual, both in method and in the answer sought. This classification of styles of thought is employed in several studies, such as Getzel and Jackson's (1962) study of creativity and Gallagher's study of productive thinking (Gallagher *et al*, 1961).

They distinguish three kinds of labeling behavior: 1) descriptive labeling, which follows the manifest physical attributes of objects, such as identifying a group of people in uniform as "all soldiers"; 2) relational-contextual labeling, which denotes a functional interdependence between objects, such as grouping a man with a cane who is wearing glasses and a boy by saying "the boy is helping the blind man across the street"; and 3) categorical-inferential, which describes subsuming an object or event under a group label which is representative of a total class, such as grouping together all things which are tools.

An interesting distinction between the analytical and constructive modes of thinking is made by Dienes (1959). He points out that:

> We know ... that some people must formulate their concepts very explicitly and exactly before they can use them, while others can think in terms of the same concepts with equal efficiency but only with a small amount of such explicit formulation. Or, again, some people, as Bartlett points out, tend to think in broad concepts, in terms of the internal relationships of the constituent concepts, while yet others build up their concepts following some intuitively realized requirements or standard. For the former, it is more the detail and its intricacies; for the latter the overall picture that counts. These might be called the analytical and the constructive aspects respectively.

Peel (1960, pp. 16-18) describes four styles of thinking: thematic, explanatory, productive, and integrative. Thematic thinking, such as the pattern employed in creative writing, is relatively free except that the associations are controlled, directed, or unified by the theme, presenting a consistent whole. The direction of explanatory thinking, employed in describing and explaining events, must conform to the practical criterion which controls the sequence of associations. Productive thinking is employed when an individual is called upon to apply his knowledge or to make use of his knowledge in new situations. Integrative thinking reveals itself in the invention of new theories or systems of thought. It embraces a wide range of apparently dissimilar operations, which actually may represent only the more "finely discriminative and majestically comprehensive variations of the first three kinds of thinking."

While these studies of styles of thinking are highly suggestive and provocative, it is difficult to translate their results into educational strategy. Further, the variance in terminology used to describe essentially similar styles makes it difficult to consolidate the ideas from these studies into a single comprehensible system.

A more serious difficulty lies in the fact that the styles of thought do not represent discernible thought processes. Rather, they are qualities or characteristics which are present in several different categories of thought processes, such as the formation of concepts, the interpretation of data, and the application of principles. As general qualities of thought, these styles are not directly teachable.

THE DEVELOPMENT OF THOUGHT

Another group of studies has concentrated on the development of thought. Noted among these are studies conducted by Piaget and his followers, referred to as the Geneva School of Thought. The theory underlying these studies is too complex to summarize here. For this reason, only a few points which have the greatest bearing on classroom teaching and learning, and which constitute a part of the theoretical foundation of the study described here, will be discussed.

Of singular importance is the central hypothesis of Piaget that there is an "invariant" developmental sequence in the growth of thought. Thinking can be described as the progressive maturation of logical cognitive operations, such as the ability to make increasingly more refined differentiations and to handle more abstract concepts and relationships.

Three main periods in this sequence are differentiated. The first is the sensory-motor stage, in which the coordination of the various senses is accomplished. The second period is that of organizing concrete operations, or operational thought, which is characterized by deriving abstract structures of thought from the manipulation of objects. In this period, the child is able to make limited and tentative alterations in the environment and to perceive abstract relationships among the variables in the objects he manipulates. Thus, the capacity to think abstractly is expressed through the manipulation of objects. These manipulations bring to light properties of the environment and, therefore, form an empirical basis for later conceptual ordering of objects and events. Even though abstraction is possible under these conditions, differentiation of the abstract properties of objects and events is still imperfect.

The third period is that of formal thought, in which the individual begins to use propositional thinking -- to work with propositions in place of things themselves. The representation becomes symbolic and acquires equivalence. The conceptual system acquires reversibility -- wholes can be composed, decomposed, and recomposed into new combinations. The individual is able to deal with the form of events or arguments independently of their particular, concrete, and immediate empirical content. Trial and error is replaced by a capacity to hypothesize the possibilities (Hunt, 1961, Ch. 6). This last form of thought is a much more powerful one, because it produces what Peel calls a "double jointed intellect" and eliminates the necessity for random trial and error. It is also a major step toward liberation from "a slavish and distorting accomodation to immediate reality," and as such amounts to a fundamental reorientation toward cognitive problems (Flavell, 1963, p. 305).

While it may be useful to think of an individual as characterized by a given cognitive structure, he will not necessarily be able to perform within that structure on all tasks. In addition, there is also a hidden uniformity within the apparent difference between one stage and another

(Flavell, 1963, p. 23).

This development of thought is hierarchical, in the sense that each succeeding stage increases the abstractness and complexity of cognitive structures and operations. The mental structures developed at any preceding stage are also prerequisite to success in the subsequent one and are incorporated into it. Essentially, this maturation takes place by a hierarchical organization, both of the information processing strategies and the symbolic representation of experience. For example, the concrete operations must precede the formal operations, for the mastery of the former is both psychologically and logically necessary for the activation of the latter. At each stage, new competencies are developed which extend the individual's grasp and control of the world and his freedom from immediate stimulus (Flavell, p. 20).

Furthermore, this continuous creation of increasingly more complex structures of mental organization or schemata is the product of interaction between the organisms and the demands of the environment. Cognitive operations can thus be viewed as products of the individual's active effort to cope with his environment, and therefore are active processes which are not fully controlled by environmental stimulation or passive conditioning.

The variety and adequacy of the schema for abstract thinking that a particular child has depend on his maturity as well as the nature of his experience, the quantity of concrete instances he has encountered, the frequency and the quality of occasions demanding reorganizations of conceptual schema to which he has been exposed, and the amount of mediation offered by adults.

ASSIMILATION AND ACCOMODATION

In its dynamic aspect, the intellectual functioning is also characterized by the invariant processes of assimilation and accomodation, in the sense that these processes operate on any level of thought, at any age level, and with any content. Assimilation means that the individual "in any cognitive encounter with the environment," of necessity organizes the objects and events into his existing cognitive structure, and invests them with the meaning dictated by that system. He perceives each new phenomenon in terms of an already existing conceptual framework, and new phenomena have meaning only to the extent that they can be fitted into patterns of concepts and relationships that already exist in his mind.

In contrast, accomodation is a process of adaptation to the "variegated demands of the environment." This process occurs when the new experience does not fit the particular conceptual schema the individual has at the moment and therefore he must rebuild or extend his schema to meet the new demands. For example, a child's concept of measurement may be that of measuring with a yardstick. When faced with something that cannot be measured with a hardstick, such as the volume of water in a jar, the child has to extend his concept of measuring to include other and different means. Eventually, he must evolve the abstract idea of measurement and distinguish it from all and any specific means of measuring. Such reorganization takes place only as he is progressively induced to cope with phenomena that do not fit his current schemata.

The assimilation-accomodation model of intellectual functioning, in effect, constitutes a germ of a theory of intelligence. In Piaget's theory, they constitute the fundamental ingredients of intelligence.

Both are present in every cognitive act, of whatever type or developmental level. However, their relationship changes drastically both within and between the developmental stages, and these alterations depend upon the kind of intellectual functioning that takes place (Flavell, 1963, pp. 44-52, 58).

THE STRATEGIES OF THOUGHT

As yet, only a few studies are concerned with strategies of thought, and still fewer deal with the complexities of these strategies under classroom conditions. Bruner and his associates (1956) have examined the strategies of concept attainment under simplified and highly controlled laboratory conditions. These conditions are a far cry from the complexities of classroom conditions which involve not only processes other than concept formation, but also chains of processes and sequences of patterns.

The strategies of problem solving are the object of a few other studies. The initial classical attempt to study strategies of problem solving was made by Duncker (1945). His method was to present a problem to a subject and then to ask him to think aloud while he was proceeding to solve it. Duncker distinguishes an organic method of problem solving from a mechanical one. The "organic" problem solver proceeds by "re-phrasing" the problem according to his insight into the structure of the problem which he has acquired from his background and experience. He may suggest at first a partial solution, then re-phrase the problem and proceed with this until he reaches an effective restatement or else discovers that his solution is none at all. He may then switch over to a different attack. In contrast, the "mechanical" problem solver applies his previous knowledge to a poorly analyzed problem and this having failed, he then tries anything by trial and error, in a haphazard order.

Duncker also describes the conditions necessary to arrive at an organic solution. It is important to understand the essential structure of the problem, to distinguish the essential from the irrelevant conditions, to decide how to vary the appropriate elements meaningfully, to analyze a situation in terms of the goal, to determine what stands between the goal and its realization, and to analyze the available materials in order to know what can be used. What direction the process of solution takes depends on the relief map (or the cognitive map) of the problem and the disposability, movability, and variability of its elements. Duncker suggests that, while knowledge and habit play a role, the thought process is the most influential factor for creating "looseness" or flexibility in solving problems. Wheeler (1958) points out, further, that individuals may suffer from functional fixedness when they become so set in their perception of objects or the relationships between their elements that they are incapable of new response. This rigidity and inelasticity makes it impossible to restructure the problem and the materials of thought.

Wertheimer (1945) analyzes a somewhat similar strategy of problem solving under the name of productive thinking. He observed elementary school children solving problems of geometry, such as finding the area of a parallelogram, and examined their approaches to these tasks. He, too, postulates that the root of all productive thinking is in the discovery of the fundamental structural properties of the problem, the ability to see relationships between the different elements of the structure, and organizing the "field" of the problem so that sensible thought can be applied to it. Wertheimer maintains, further, that problem solving processes prepare the student's reasoning powers so that he can use the generalizations he has already acquired constructively and productively in further thought. To do this, students must acquire a perspective on the problem to which a generalization, a fact, or an operation applies. They need to understand the essence of the problem to be able to select and assemble from previous experiences knowledge that applies sensibly and significantly. Sensible application of previous knowledge requires a reasonable restructuring of the problem in order to see it in a new perspective.

According to Wertheimer, the difference between prescriptive and productive learning lies in the delicate balance between what is given to the student and what cognitive operations he is asked to perform upon that which is given. Prescriptive teaching, or giving the student what he should discover himself, produces non-adaptive learning because such teaching does not allow the student to acquire a rational understanding. The learner can only perceive each new learning task as similar to one he has mastered before, and is therefore predisposed to reinstate in the current situation the mental acts which he has used previously. In this sense, one can say that prescriptive teaching prevents a creative use of the mind, and prevents the transferability of learning.

More recently, Suchman (1962, pp. 29-42) has attempted to study the methods of generating autonomous inquiry in elementary school age children. His methodology consists of presenting children with silent motion picture demonstrations of problem episodes in physics. Each of these problem episodes illustrates certain key principles or causal conceptions of physics. Currently, he is extending the problem episodes to include the subject matter of biology and economics. These episodes are designed to baffle children, or to create a "cognitive dissonance" and thereby a "set" for search and inquiry.

The children are then faced with the problem of how to explain the phenomena. The children begin the inquiry by asking questions. They are required to phrase their questions in such form as to be answered with a "yes" or "no". A child may continue asking questions until he voluntarily relinquishes the floor. These conditions permit the children to get information only if they learn to ask productive questions and to structure their probes. They cannot do "brain-picking."

The training in inquiry process follows a sequence which begins with the analysis of the presented episode to verify the available facts. These facts are then examined for their relevance. Finally comes the task of explaining the observed phenomena by ascertaining the principles and relationships which govern the changes shown in the film. Suchman calls this the induction of rleational constructs. The individual is now forced to bring to bear his existing conceptual systems in hypothesizing causal relationships and testing them.

Suchman's study of inquiry training involves both an analysis of the elements of thought and of the strategy of inquiry which children pursue. He postulates that the cycle of operations in autonomous inquiry involves four types of action: searching, processing, discovery, and verification. Each activity in turn involves certain more specific processes. For example, data processing consists of analysis, the breaking down of complexes into their component parts; comparison, or the bringing together of comparable elements to discern differences and similarities; isolation, or a selective separation of and attention to small groups of variables; and repetition, or repeated juxtaposition of elements of data to decrease the probability of unrecognized elements.

Certain common features can be found in all these studies of strategies of thought. First, all postulate that there is a generic method of inquiry and/or problem solving which is relatively independent of the content. The relative role of a generic method of inquiry and of the mastery of appropriate information in thinking has been debated for a long time, and is under scrutiny again today. Obviously, thought cannot proceed from nothing. Yet the way of acquiring needed information may induce a restrictive "set" which may prevent the restructuring of the problem and limit productive thought and autonomy of inquiry. Emphasis on acquisition of meaningful knowledge, which is often regarded as an efficient alternative to discovering the structure of the problem and the principle for solving it, does not resolve the difficulty, because it is difficult to define meaningfulness without reference to the context in which the knowledge is used. (Taba, 1963).

It must be remembered also that a relationship exists between the level of abstraction in conceptualization of which the problem solver is capable and the aspects of the structure of the problem which he can perceive. The higher the level of abstraction or the larger the "scope of representation," to use Bruner's terminology, the greater the possibility of devising a simple structure for solving a problem. The greater the range of elements which can be considered as only incidents of the general case, the more encompassing the solution. In other words, capacity for abstraction can extend the control over possible solutions. Inversely, a lower level of abstraction tends to produce more scattered organizational patterns in problem solving, a more complex structure of the problem, and a design for its solution which encompasses fewer elements.

The studies of strategies of thought described above also assume that the fundamental intellectual activity is that of "discovering" the structure of the problem, the chief principle and the main causal relationship between the events. In this discovery process is seen the possibility both for developing autonomy in thinking and the possibility for transfer of methodology and of knowledge.

These studies all also suggest or actually propose a new strategy and a new role for the teacher, to stimulate cognitive processes. In order to guide the process, the first requirement for this strategy is that teachers themselves have a cognitive map of the concepts and mental operations involved in the various learning tasks. They must be able to diagnose the type and the level of thought processes children bring to these tasks. They must, further, employ methods which maximize the autonomy of thought and follow a psychologically calculated sequence for attaining it. Finally, it is necessary to distinguish the methods of instruction which produce an efficient fact-holder from those which generate creative and productive thinking. These two goals are not mutually exclusive. As Peel points out, "we need a balance between over-information and freedom, a poise between lack of information and the fettering of imagination by too much of it." (Peel, 1960, p. 171).

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CHAPTER II

THE PREMISES AND THE OBJECTIVE OF THE STUDY

It is inevitable that one research study should feed on others preceding it, by utilizing the concepts employed, specific findings, and methodologies. The study of Thinking in Elementary School Children described here is in debt to preceding studies in all of the above respects.

THE NATURE AND THE DEVELOPMENT OF THOUGHT

Some concepts which guided the current study were those that were concerned with the nature of thinking and the development of cognitive skills that have been clarified and reinforced by concepts borrowed from the labor of researchers described in the preceding chapter. Among these was the concept of thinking as an active transaction between the individual and the demands of his environment, which is neither fully controlled by environmental stimulation, nor wholly independent of some mediating intervention. The action principle of the nature of thought is expressed in the concept of thinking as an active organizing and reorganizing of mental schema by the individual with which to condense the kaleidoscope of environmental stimulation and to give meaning to it. As Flavell (1963, pp. 366-368) points out, enduring understanding of the world can only be acquired through an "active commerce with this world on the part of the knower." The materials of the environment become available to individuals mainly through performing cognitive operations upon them. These operations cannot be "given" by a teacher or anyone else. They "must be performed by the learner to be acquired at all. One can only assist the internalization and schematization process by getting the students to perform the requisite actions which progressively less and less direct support from the external givens."

Another useful concept is that of a necessary sequence in the development of thought, such as that concrete or operational thinking must precede the abstract and formal thought. This idea of a sequential order of steps in the development of thought seemed to offer a fruitful model for conceptualizing the career of learning of the various modes of thinking during the school years.

Assuming a sequential order in the development of thought, there should also be a sequence in learning experiences so that each preceding step develops the skills which are prerequisite for the next step. For example, because the transition from concrete to operational thinking is of especial importance for school age children, the sequence of school experiences should begin with experiences with concrete objects, materials to facilitate description, analysis, and differentiation. The early years of school may need to concentrate on providing abundant experience in manipulation and combining, matching and grouping objects in order to facilitate the mastery of concrete thinking. Opportunities for the active processing of information may provide the necessary conditions for the evolution and organization of abstract conceptual schemes. This preparation lays the groundwork for formal thinking, for manipulation of abstract symbols, and for the capacity to discover relationships between objects and events.

This sequence may apply not only to the general stages in the evolution of thought from infancy on, but also to the maturation of cognitive operations during a school year, and beyond that, to mastering the specific skills in certain cognitive processes such as classifying, interpreting, and generalizing. These processes may also involve steps in which each preceding operation is a necessary precursor of those that follow. For example, a child may need to examine concrete instances representing a generalization in order to learn to generalize. Grouping and classifying require the capacity to isolate the specific properties of objects and events under consideration.

The concepts of assimilation and accomodation have pertinence to conceptualizing the dynamics of learning cognitive processes and, consequently, to conceptualizing teaching strategies. Stated in ordinary terms, this concept suggests the value of rotating the experiences of absorbing information with those that challenge reorganization of mental schema for organizing the information. It suggests, further, that faulty or inadequate schema can be challenged by having students face examples or information which are dissonant with their current schema, so that they are required to revise it. This is different from "correcting" the student, in that the task of reorganization is the student's rather than the teacher's. To be successful, this strategy of rotation must offer a challenge that is sufficiently beyond the student's present schema to induce accomodation, and yet not so far removed that the student cannot make the leap.[x]

THE ROLE OF TRAINING

Crucial to the problem of development of thought is the issue of assisted and unassisted development, or the issue of training. Ordinarily, the accumulation of experience accounts for the emergence of new thought forms and therefore appears to be related to age. However, it is conceivable that when training in thinking is introduced, formal thought may appear much earlier than has been suggested by studies of "untrained" children, or of children whose training has been too brief or limited in focus to be effective. Adult help in decoding representations, for example, may make certain thought forms more readily available to children and enable them to use these at at earlier age. This possibility has occurred to several researchers.

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[x] See Chapter I, pp. 13-14

Burt (1931) suggests that primary children may be taught to reason formally in simple arithmetic if they have learned arithmetic skills by discovery. Isaacs (1948) gives several examples of formal thinking in young children. Wheeler (1958) points out that "most of the elementary schema necessary for valid thinking are already within the capacity of the average child of seven ... Subsequent development consists chiefly in a more experienced use of these capacities and in an increasing complexity of the problems which the child is able to solve." He concludes that this capacity can be trained, and that "it can manifest itself at a much younger age than teachers have hitherto assumed." Ervin (1960) hypothesizes that training may alter the pacing in the development of thought as described by Piaget.

Conscious planning of training experiences may make it possible for children to master logical operations at an earlier age which under natural conditions are characteristics of a later age, such as an earlier transition from concrete operational thought to formal thought. Suchman (1962) is experimenting with the training of children in what he considers to be the generic inquiry method, and is trying out this method in the context of especially constructed episodes illustrating the principles of physics, biology, and economics.

These hypotheses regarding the accelerating effects of training in thinking are supported by recent analyses of the structure of intelligence. Studies by Guilford (1960), Miner (1957), and Sigel (1963), for example, suggest that intelligence is not as fixed a capacity as has been presumed in the conceptions underlying some intelligence tests. Neither is intelligence a unitary capacity, but a composite of many different factors, some of which can be readily identified as reasoning or thinking. These studies also indicate that experience has a great deal to do with unlocking the intellectual potential and with converting it into functioning capacity. These observations regarding the nature of intelligence suggest that under appropriate stimulation and training, gains in cognitive functioning may show a low relationship to scores obtained on current intelligence tests.

A similar suggestion was put forth by Bruner (1963, p. 7) in a recent statement to the effect that higher levels of intellectual operations can be induced by giving children "the best hints, the best tools, the maximum theoretical props and formulae."

In effect, then, it seems that how people think may depend largely on the kinds of "thinking experiences" they have had.

RELATIONSHIP OF THOUGHT TO CONTENT

An interesting pedagogical issue emerges from the considerations of the relationship of thought to the nature of the context or content with which it deals. It pertains to the extent to which the basic cognitive processes are generic and, as such, independent of the content requiring their use. Should the process be generic, differences in the structure of the disciplines from which the models for thought systems are derived would be irrelevant. There would be no need for studies of thinking to sample the various subject areas.

Considering the previously cited research on cognition, there is considerable reason to be concerned about the fact that current research and curriculum experimentation are concentrated largely in the fields of science and mathematics. The models of thought emerging from these studies are likely to bear an imprint of the kind of thinking appropriate to these disciplines. The question is whether the models and processes of thought which are appropriate to science and mathematics are equally appropriate to areas such as the social studies and literature. There is substantial evidence to the effect that each subject field has its own distinct structure, in the sense of involving a distinct set of concepts, a distinct way of asking questions about the world, requiring different levels of precision, and distinct approaches to solving problems. This would suggest that, while there may be generic aspects to the methodology of inquiry which cut across all types of content, there may be sufficient variations which make it necessary to postulate different strategies of conceptualization and thinking in each major discipline. For example, the problems and phenomena in social and human disciplines usually involve multiple causation and probabilistic reasoning. To deal with these phenomena, it may be necessary to apply a whole series of principles to predict or explain anything, and conclusions, no matter how carefully formulated, may remain in the realm of probability rather than certainty. The generalizations in science are usually more universal than those in social and humanistic disciplines. For example, the principle of gravity is universal, at least on this planet. A stone will fall in the same manner in Mexico City as in Moscow. It is more difficult to predict the behavior of revolutions, because inevitably the revolutions come about differently in these two places (Taba, 1962, pp. 181-184). It seems almost as though there were danger in the very tidyness and elegance of structures of the mathematical concepts, when conceived to be the ideal form of thought. The point is especially important if one assumes that conceptual schema and the ways of relating and processing information are internalized and become a part of the mental equipment of the individual.

There is no doubt that much about thought is generic and highly transferable. However, it is not clear to what extent this is so. Descriptive studies of the patterns of thought indigenous to a variety of contrasting disciplines are needed before the issue of generic and specific training in thought can be settled.

Another issue is that of the extent to which training in thinking needs to be emphasized consciously and the extent to which the necessary cognitive training is provided simply by "penetrating the structure of content" and by following the sequences of thought dictated by that structure. Some curriculum experiments, especially those which concentrate largely on producing texts and sequences of materials, seem to take it for granted that content organization automatically provides training in the development of necessary thought processes. Since the structure of the subject is most easily discernible in fields like mathematics and science, it is easy to be deluded into thinking that proper arrangement of content automatically provides an appropriate sequence for learning the required cognitive operations.

THE OBJECTIVES OF THE STUDY

The central objective of the study was to examine the development of thought under the optimum training conditions. These conditions were defined as follows: 1) a curriculum designed for the development of thought; 2) teaching strategies focused explicitly and consciously on the mastery of the necessary cognitive skills; and 3) a sufficient time span to permit a developmental sequence in training.

In fulfilling the first of these conditions, the classrooms in the study followed a social studies curriculum which was organized around basic ideas as targets for learning. Rather than placing the emphasis upon covering content, the curriculum design provided for a careful sampling of specific details in terms of their relevance to the formation of basic content ideas. The sampling of the specific content also served to reduce the amount of sheer mastery of content, thus releasing time for depth study of the basic ideas and for the learning of the necessary cognitive skills.

The curriculum outline contained, in addition, a detailed sequence of learning experiences. This sequence provided ample opportunity for inductive development of concepts, such as for manipulating concrete events and phenomena before inducing students to develop general ideas about them. These learning experiences were also programmed for a developmental sequence in evolving generalizations, for systematic opportunities for comparing and contrasting to enhance the capacity to analyze and to abstract, as well as for practice in applying known principles and facts to explain new phenomena. In a rough way, the curriculum incorporated the principles of sequence, of rotating assimilation and accomodation, and of the active organization of autonomous conceptual schema. (Contra Costa County Social Studies)

To provide for the second required condition, namely adequate teaching strategies to facilitate the learning of cognitive skills, special training of teachers participating in the study was undertaken. This program of training is discussed in Chapter IV.

It was postulated that under these conditions, a higher level of thinking may be possible at an earlier age than the findings from studies conducted with untrained children or with children receiving limited training would indicate. It was postulated, further, that this increment in the level of thinking is not confined to students of high ability as measured by intelligence tests. These hypotheses were based on the assumption that a careful observance of of the developmental sequence in a training program will accomplish the maturation sequence more rapidly than is possible under the accidental accumulation of experience.

In addition to this central objective, the study pursued several subsidiary objectives. One was to develop a method of categorizing thought processes for analyzing thinking as it occurs in the classroom setting, and which could provide leads for improving instructional strategies for the development of thinking.

Another subsidiary objective was to examine the effect on the development of cognitive processes of such factors as ability, age, and cultural background. Does training have a different effect on students of differing ability levels? Do older students attain a greater proficiency than do younger students under similar exposure and amount of training? Are there either qualitative or quantitative differences in the nature and level of cognitive functioning in students of adequate and deprived cultural backgrounds?

Finally, it was necessary to create the methodological tools and instruments with which to secure the necessary data under classroom conditions. As will be discussed in Chapters VI and VII, only meager beginnings have been made in developing the tools which capture the classroom interplay of teaching strategies and cognitive development.

In the initial conception of the study of thinking in elementary school children, the idea of teaching strategies was allotted a subsidiary role. The plan was to offer teachers training in guiding the formation of cognitive skills in order to provide one relevant factor in the development of these skills. However, as the study proceeded, the role of teaching strategies assumed greater significance. It became apparent that teaching strategies have a strong effect both on the scope and the level of thinking in the classroom, and therefore the development and the nature of these strategies merited an independent analysis. It was necessary that teaching acts and student responses be treated as a reciprocal transaction in which one generates and influences the other, and both together are responsible for the end product, the quality of learning. As a result, the study concentrated on an analysis of three dimensions of the transactions between teachers and students: 1) The behavior of the teacher; 2) the behavior of the student; and 3) the content or the product of their interaction.

THE CATEGORIES OF THOUGHT PROCESSES OR COGNITIVE TASKS

As the discussion of the studies of thinking indicated, it is possible to approach the analysis of thought from several different angles. For the purposes of this study, the identification of specific processes and of the strategies for mastering them seemed most promising. After considerable exploration of the dimensions for analyzing thought processes, the study focused on three clusters of these processes or cognitive tasks: 1) grouping and classification of information; 2) interpretation of data and the making of inferences; and 3) the application of known principles and facts to explain new phenomena, to predict consequences from known conditions and events, or to develop hypotheses by using known generalizations and facts. Critical thinking, per se, was excluded because the curriculum was not explicitly designed for this purpose.[x]

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[x] These clusters of thought processes are similar to those developed by the Eight Year Study Evaluations Staff for the purposes of developing evaluation instruments. E.R. Smith and R W. Tyler Appraising and Recording Student Programs, New York: Harper, 1942

These three cognitive tasks were analyzed from two different angles: the operations or elements involved, and the sequential steps necessary for mastering them.

Concept development is considered to be the basic form of cognition on which all other cognitive processes depend. This fact may explain the relative abundance of studies devoted to concept development, in comparison to other categories of thought processes.

For the purpose of this study, concept development was defined as consisting of three different processes or operations: 1) The differentiation of the specific properties of objects or events, such as differentiating the materials of which houses are built from other characteristics of houses. This differentiation involves the process of analysis, in the sense of breaking down the global complexes representing objects and events into specified properties; 2) grouping, or a process of assembling specified properties across many objects and events, i.e., grouping together hospitals, doctors, and medicine according to some semi-intuitively identifiable basis such as representing something to do with health, or the fact that their availability serves as an index for the standard of living; and 3) labeling or categorizing; i.e., explicitly identifying the basis for grouping, and subsuming the items under some label or category.

In the classroom, differentiation may be called for in the form of enumeration, either from recall from previous experience, or by specifying items noted in a complex presentation, such as a film or a story. For example, students could list the materials used for building houses, or name things and events noted in a film. Grouping occurs in the form of putting diverse items which have some common characteristics, such as grouping schools, hospitals and parks as community facilities. Usually, this process of searching for a basis of grouping leads to a discovery that the items can be grouped in multiple ways, depending on the purpose and the basis used.

Labeling occurs in the form of making decisions about what to subsume under which category, such as whether weather is to be subsumed under climate, or vice versa. This involves an awareness of orders of sub- and superordination.

In teaching these operations, as well as in analyzing them, the hierarchical nature of concepts must be kept in mind. As the process of abstracting continues, the categories or labels become increasingly more abstract and encompassing and thereby more remote from the initial concrete referents. This increasing abstraction also enhances their power as cognitive tools for organizing information. In the classroom, concepts on different levels of abstraction may be suggested simultaneously, which creates the problem of differentiation. For example, students may enumerate materials for building housing in specific terms, such as tar paper and fiber glass, or in classes, such as insulation.

Interpreting data and making inferences from them is essentially an inductive process of developing generalizations, although never accomplished without some application of what is previously known. This task involves four basic operations: one is that of assembling concrete information, either by instigating a process of recall and retrieval of previously learned information, or by being presented new information and identifying the specific points in this set of data. This is a basic operation and somewhat similar to the first step in grouping and classifying. Second is that of explaining or giving reasons for certain events, such as explaining why the way of life in California changed when harbors were opened for free trade, or giving reasons for the desire of the early colonists to change their form of government.

The third operation consists of relating different points of processed information, such as is involved in comparing the proportion of white population in Brasil and Argentina, and relating the information thus obtained to their possible effect on standards of living in the two countries. The fourth operation is that of formulating a generalization or an inference, such as that in Latin America the countries with predominantly white population tend to have a higher standard of living.

While these processes are generic, there are differences according to whether the content being interpreted is scientific or literary, whether the data are couched in quantitative or verbal symbols, or whether they are concrete or abstract. Greater precision is required, and fairly rigorous limits are set, for extrapolation and interpolation when interpreting quantitative data, while "reading between the lines" is almost a necessity in interpreting literary passages (Taba, 1962, p. 216 and Ennis, 1962).

APPLICATION OF PRINCIPLES

A third cognitive task has to do with applying previous knowledge -- principles, generalizations, or facts -- to explain new phenomena and to predict consequences from known conditions. For example, if one knows what a desert is like, what way of life prevails there, and how water acts on the soil, one can predict what would happen in a desert if water were available.

Essentially, two different operations are involved: that of predicting, and that of establishing the parameters either of logical relationships or of information by which to test the validity of predictions. The level of a prediction or a hypothesis can be judged according to the extent of the leap from a given condition. But equally important is the completeness of the parameter -- the chain of links which connects the prediction and the conditions. For example, the prediction that grass will grow in the desert if water is available is a prediction of a lower order than is the prediction that nomads will become farmers, and entails a shorter and a simpler chain of causal links.

Application of principles invites a greater degree of divergence than either of the preceding cognitive tasks. Each condition presented as data invites a divergent line of predictions. For this reason, this process contains opportunities for creative and divergent use of knowledge. In fact, some tests of creativity use situations involving prediction; but they use conditions which set few constraints and therefore permit an unlimited exercise of ingenuity.

In social situations, these processes also provoke value judgments and stereotypes. For example, in explaining why delinquency exists or predicting how it will change if certain measures are employed, it is necessary to consider not only the factors affecting human behavior, but also what beliefs prevail about equality, justice, democratic values, deviate behavior, and adolescence (Taba, 1962, p. 217).

The operations involved in applying principles are quite crucial to developing productive patterns of thought. This process is the chief vehicle for transfer of knowledge. This is the chief process on which the transfer of knowledge depends, and therefore a crucial one for getting mileage out of what little the students are able to acquire directly during their schooling. It is a chief means for creating new knowledge by logical processes, and a way of acquiring control over wide areas of new phenomena. It is also the process by which models for hypothesizing can be created, freeing the individual from the necessity of being bound to the immediate stimulus.

As conceptualized in the study, these three cognitive tasks have several things in common. First, the mastery of operation in each task -- concept formation, interpretation and inference and application of principles -- entail a sequence of steps. For example, in order to form general concepts from diverse specific information, the operations need to be mastered in a certain sequential order: enumeration combined with differentiation ⟶ grouping which involves determining the basis for grouping ⟶ categorization and labeling, which involves creating superordinate classes.

Despite the differences in the operations and in the specific steps, the sequences involved in mastering these steps are similar in that all involve hierarchies of levels of abstraction and complexity. Each successive step in all the cognitive tasks involves more complex operations than does the preceding one. Each step also, in a sense, represents an increment in the leap from that which was originally given.

Finally, the sequence of operations required in the successive steps involve different degrees of intuitive performance and of conscious awareness of the principles involved in the performance.

The concept of the hierarchical order in the complexity and abstractness of the operations became the basis for scaling cognitive performance in the transcripts of classroom discussions described in Chapter VII.

Indirectly, this conception of the hierarchical difficulty in levels of mental operations also involves the principle of assimilation and

accomodation. In interpretation of data, for example, accumulating descriptive information is followed by explanation, which requires transformation of descriptive information into explanatory information. In the sequences involved in applying principles, the offering of intuitive and fairly unconstrained predictions or hypotheses is followed by challenging their validity by constructing the informational and logical parameters to justify them.

METHODS OF SECURING DATA

As the locus of this study was the classroom, rather than a laboratory situation, research methodology had to be developed which differed from that ordinarily employed in highly controlled research. The triple focus, of studying simultaneously the thinking of elementary school children, teaching strategies, and the effect of the latter on the former, created additional problems of research methodology.

Two types of criterion methods were devised. Since there are practically no tests of thinking available on elementary school level, two tests were developed: The Social Studies Inference Test and the test on Application of Principles. The first of these tests achieved a fairly dependable form, and was used as a pre- and post-test. The latter turned out to be too complex to be formulated adequately enough in the brief time available, and was used only for explorative purposes.

The objectives of the study involved examination of certain dynamic qualities of thought for which highly structured tests may not be the most adequate measuring tool. Paper and pencil tests, no matter how well developed, inevitably provide data only on the end products of thinking, and neglect the dynamics in the evolution of thought. Furthermore, test

results provide only indirect information, by inference, on the effect of teaching strategy and curriculum on the end product.

For this reason, the taping of classroom discussions involving the three cognitive tasks was added. To use data from this source required the development of a coding system by which to analyze the thinking of students in relation to the verbal behavior of teachers, and to assess these products in terms of some criteria of success which would permit the scaling of thought according to the levels of maturity, complexity, or abstraction. In fact, the study attempted to combine evaluation of all three. These methods are described in subsequent chapters.

For information about the factors which may affect the learning of thought processes, the usual set of data were secured: data on ability, achievement, and the socioeconomic status of the students.

The limitations in the development of the criterion measures used in this study should be noted. Because of time limitations, optimum test development procedures could not be employed. Prior to use in the study, the development of the Social Studies Inference Test was limited to judgments of experts in social studies, to a small number of individual interviews with children, and preliminary trials in a few classes not involved in the study.

Devising the coding scheme for evaluating the classroom discussions entailed even greater disadvantages. A circular process had to be employed in which the coding scheme, which could not be developed beforehand on independent data, was generated from the very tapescripts upon which it was to be used. For example, the coding system for the fourth discussion, which was taped at the end of the school year, was not completed until the end of July. This gradual evolvement of the coding system did not leave sufficient time to explore the cross discussion coding as fully as might have been desirable. Neither was it possible to experiment with the ways of determining the relative difficulty levels of the three cognitive tasks. A full discussion of the procedures employed in developing these criterion measures is presented in Chapters VI and VII of this report.

CHAPTER III

TEACHING STRATEGIES[x]

There has never been, and is not now, sufficient appreciation of the complexity of the job we call teaching. Current today is the paradigm of teaching which consists of scattered ideas and conceptual models which are shot through with questionable assumptions. These assumptions have persisted stubbornly through decades of research data to the contrary. Neither an adequate theory of teaching nor a set of satisfactory paradigms are available to conceptualize the individual teaching acts, let alone the teaching strategies and their effects on learning. Yet, what Gage (1963) said about the role of paradigms in research also holds for paradigms of teaching. Drawing on Thomas Kuhn's The Structure of Scientific Revolutions, Gage suggested that a good paradigm solves crucial problems, eliminates anomalies, and improves the match between the facts and the paradigm's predictions. Having a good paradigm makes it unnecessary for scientists continually to examine the first principles and to justify themselves. Good paradigms also determine what problems are available for study, provide model problems and solutions to a community of practitioners, a "way of seeing the world," "conceptual boxes," a "set of commitments," as well as an intertwined body of theoretical and methodological beliefs (Kuhn, 1962).

ASSUMPTIONS ABOUT TEACHING

One or another simplified assumption has prevailed about the nature and function of teaching. Among the simplest and most stubborn has been the notion that the chief, if not the only, function of teaching is to impart knowledge. Currently, this conception of teaching is again in vogue. Such a concept of teaching underlies, for example, the recent Conant (1963) report on teacher education. According to this assumption, the knowledge of content areas to be taught bears a simple relationship to the effectiveness of teaching. A spate of recent plans for improvement of school programs testifies to the fact that the mastery of content to be taught is regarded as the sole guarantee of effectiveness in teaching.

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[x] Portions of this chapter have appeared in the article "Teaching Strategy and Learning," California Journal for Instructional Improvement, Vol. 6, No. 4, December, 1963

Another widely accepted assumption is that teaching is the product of mastering certain specified methods for certain subjects such as history, physics, or arithmetic. A large portion of teacher education -- the methods courses -- is predicated on this assumption. Often, the concept of methodology is further narrowed down to the method. For example, acrimonious debates about the teaching of reading consist largely of pitting one method against another as the one that is best for teaching children to read. This concept of teaching not only takes for granted that there is one "right" method to teach anything, but that this method is equally effective in the hands of all teachers, for all kinds of children, and under all varieties of learning conditions (Medley and Mitzel, 1963). It also implies that a particular method can be developed and applied apart from the larger theory of learning and teaching.

A third assumption is that good teachers are born, not made. Those operating on this assumption transform teaching into a sort of mystique, an art, the secrets of which a few "good" teachers grasp intuitively or stumble onto accidentally. Such a conception practically bars an objective analysis of the processes of teaching or learning, and denies the possibility of imparting that "art" to prospective teachers by such ordinary means as education.

RESEARCH ON TEACHING

Criticisms are also voiced about the nature of the theoretical framework or paradigms of teaching and learning underlying research on teaching and teacher education. The most basic is the charge that the concepts of method have been inferred from studies of learning carried on in situations which have little or no relationship to the classroom. Page (1962) for example suggests that there has been a gross misapplication of behavioral sciences, especially of psychology, and that both the psychologists and educators have engaged in verbal magic in translating their findings, which are applicable only to a very limited situation such as reactions of hooded rats to electric shock in a laboratory, first to behavior in general, and then to learning in the classroom.

Partly because of this verbal magic, models for conceptualizing teaching tend to be in global terms which makes it impossible to establish a relationship of a given method to a particular learning theory. The result is a lack of integration between the models of teaching methods and those of learning. If one concedes, further, that there is a lack of adequate differentiation between different types of learning, such as learning facts, developing a skill, learning to think, and acquiring an attitude, it is not surprising that principles of learning relevant to one type of learning are applied to all types of learning. This had resulted in overgeneralizing from one particular principle of learning, such as reinforcement (which has only a limited applicability), to developing teaching strategies for types of learning which this particular principle does not cover. This has been the role of the reinforcement principle in developing teaching machines which purport to have vastly broader functions.

Because of a lack of adequate theoretical models, studies of teachers and of teaching have barked up the wrong tree, so to speak. The studies of the relationship of teacher characteristics to effective teaching are examples of this. After reviewing numerous studies of teacher personality and effective teaching, Getzels and Jackson (1963, p. 574) conclude that:

> Despite the critical importance of the problem and a half-century of prodigious research effort, very little is known for certain about the nature and measurement of teacher personality, or about the relation between teacher personality and teaching effectiveness. The regrettable fact is that many of the studies so far have not produced significant results. Many others have produced only pedestrian findings. For example, it is said after the usual inventory tabulation, that good teachers are friendly, cheerful, sympathetic, and morally virtuous rather than cruel, depressed, unsympathetic and morally depraved. But when this has been said, not very much that is especially useful has been revealed. For what conceivable human interaction -- and teaching implies first and foremost a human interaction -- is not the better if the people involved are friendly, cheerful, sympathetic, and virtuous rather than the opposite? What is needed is not research leading to the reiteration of the self-evident, but to the discovery of specific and distinctive features of teacher personality and of the effective teacher.

Sarason and Blatt (1962) go as far as to say that teaching and teacher education is an unstudied problem.

Evaluation of teaching effectiveness for purposes of research on selection and retention is also drawing a barrage of criticism. Medley and Mitzel (1963, pp. 83-84) describe one circular research process which goes as follows:

> Research in teacher effectiveness began with studies in which large numbers of laymen were asked to recall great teachers they had once had, and tell the investigator what characteristics made them great. The investigator would then classify and summarize these characteristics and publish some sort of list. Later, researchers refined this method by asking only people qualified as experts, a large part of whose expertise

> must have consisted in familiarity with these very same lists, to identify the effective teachers. The final refinement was to have the experts rate teachers' possession of qualities which, according to the same lists, were characteristic of effective teachers. Nowhere in this circular process was there verification of the assumption that teachers originally judged to be more effective were actually producing greater changes in pupils than teachers identified as less effective.

In addition, rating as a device for evaluating teaching effectiveness suffers from the fact that different raters use different criteria of effectiveness, and that often these criteria or their observable indices are not too clearly defined.

The fundamental trouble with both studies of teacher characteristics and rating of teacher effectiveness is that both are based on an inappropriate paradigm which defines teaching as a series of discrete competencies, behavior, or characteristics. Teaching is an organic complex in which each individual act, such as an effective response or content structuring, acquires a different meaning depending upon the nature of the whole teaching-learning situation.

The difficulty of assessing the effectiveness of teaching without comparing teacher behavior to the changes it produces in students is quite evident. This criterion has been applied only in a few studies, and only with moderate success. This has been partly because of defective analysis of what teaching effectiveness is, and partly because available instruments measure only a limited scope of student achievement.

Throughout the problems of studying teaching and evaluating its effectiveness runs the difficulty of a lack of differentiation between the processes required by the different categories of learning referred to above. And in turn, this lack causes defective articulation in teaching strategies to accomodate these differences.

The difficulties mentioned above have retarded research on teaching and have handicapped experimentation with teaching strategies in school situations. They have also affected teacher training, which tends to center either on specific packaged devices offered as methods for different subjects, or on generalized philosophical principles of "good teaching" offered as injunctions, with insufficient bridges from theory to practice to enable a teacher to implement them in classroom instruction. Neither of these approaches seem to have sufficiently affected prospective teachers to prevent them from reproducing in their teaching the methods by which they themselves were taught, or from imitating the influential staff members in the schools which they enter. Thus, both the conceptions of teaching and the ways of teacher training seem to conspire to regenerate the most tradition-bound teaching styles, which are inadequate for coping with the complexities of the teaching-learning situation in schools today.

RECENT SIGNS OF CHANGE

Under the twin impact of continued criticism of education and an increased flow of money into research and experimentation, a new interest has been kindled in the theory of instruction and in the analysis of the teaching process. Conviction is growing that to understand either, we must study teaching as it occurs in the classroom instead of inferring its effectiveness from the personality characteristics of teachers, or from a general list of a priori competencies. The model of assessing teaching effectiveness is also changing toward a concept of evaluating the interaction or transaction between teacher behavior and students' behavior.

In this shift of the focus of studying teaching and learning in the classroom and the emphasis on interaction, the description of teaching acts has become the chief tool for securing information. Recent studies of teaching focus on the description of teaching acts by grouping the observed teacher behavior or the transcription of classroom interaction into certain functional categories. Different researchers use different categories of functions, depending upon their particular theory about what is important about teaching.

Smith (1950), who was one of the first students of teaching through an analysis of classroom interaction, maintains that in order to develop an adequate theory of didactics, a description of the actions of teachers must first be made, and then translated into tactics of teaching. He believes that such a description would cut through the verbal curtain represented in such terms as "method," "problem solving," "induction," and "deduction," and free us to look at the actual instructional operations which may differ from what our linguistic commitments may have led us to believe. He classifies teaching acts according to certain logical categories of operation such as defining, classifying, comparing, contrasting, evaluating, directing, and admonishing.

Flanders (1963, p. 255 and 1962, p. 31) has been interested in describing the effect of teacher behavior on classroom climate and goals. In his interaction analysis he uses ten categories to sort out the behavior of teachers and students. Seven of these ten describe teacher behavior as follows: accepting feelings, praising and encouraging, using ideas of students, asking questions, lecturing, giving directions, criticizing or justifying authority. The first four he describes as indirect teacher influence, and the last three as direct influences. The indirect influence is assumed to expand the freedom of action the student has and to make him less dependent upon the teacher. By compiling these types of behavior into interaction matrices, Flanders (1962, pp. 50-62) plots the concentrations of direct and indirect influence, and from the ratio of the two infers their impact of teaching acts on students.

Marie Hughes's (1959, pp. 62-89) analysis of the teaching acts is somewhat similar, in that she is also interested in control and freedom. Among the categories she uses to describe teacher acts are: controlling, or the acts which tell children what to do, how to go about it, and who should do what; facilitating, such as checking, demonstrating, and clarifying; content development, such as elaborating the structure of the problem under consideration, or building up data for generalization; personal responsiveness; and positive and negative affectivity. From the frequencies of the teacher acts falling into these categories, she infers certain qualities of teaching and their impact upon what students learn. For example, a large percentage of controlling acts in the repertory of teacher behavior is taken to indicate the tendency to limit students' intellectual activity to memory and recall, while a large percentage of acts designated as content development implies that mental processes other than recall were being developed.

One final step in the rather rapid evolution of the concept of teaching reflected in recent research is the idea that, since the student equally with the teacher is an agent of his learning, and hence also of his success or failure to learn, it is impossible to evaluate the effectiveness of teaching without at the same time determining what the student is doing (Aschner, 1963, p. 53).

THE CONCEPT OF TEACHING STRATEGIES FOR COGNITIVE DEVELOPMENT

For training purposes as well as for the design of the study, a paradigm of teaching was evolved which included several concepts about teaching. First, teaching was viewed as an extremely complex process which included a variety of activities ranging from imparting knowledge to asking questions; from setting tasks to organizing steps for accomplishing them; from creating models of thought to guiding the discovery of ideas and concepts.

It appeared also that training, as well as the analysis of teaching strategies, would be more productive if instead of treating teaching as a global process, an effort were made to identify the particular learning tasks, and to project teaching strategies focused on these tasks. Further, it seemed important to develop these strategies in terms of the theoretical framework concerning the targets for learning -- in this case, a particular set of cognitive tasks.

Finally, it seemed necessary to study not the separate teaching acts, but their patterns and combinations, which were defined as teaching strategies. These strategies were conceived as consciously formulated plans for bringing about particular behavioral changes in students. Such plans are translated into conditions and activities of learning, arranged into sequences according to both the logical requirements of the learning tasks and the psychological requirements of the learners. While some aspects of the strategy are predetermined, others evolve in response to diagnosed learning problems as the interaction between students and the teacher evolves.

In addition, in formulating adequate teaching strategies, it seemed necessary to take into account several general factors. First among these are the general principles of learning, such as the ways of pre-

disposing students to learn and the kinds of stimulation needed for cognitive development. Second is the nature of the learning task and the requirements set by this task. For example, assigning chapters in the text is an appropriate teaching technique if the chief objective is to transfer as much knowledge as possible from the book into the heads of the students. However, such a method of teaching is probably not the most appropriate if the purpose is to generate the ability to draw inferences from data or to apply known principles to solve new problems. Third, since learning acts usually are related to certain content, attention must be paid to the logical structure of that content, to retain its unique nature while organizing it for optimal learnability. Finally, certain facts about learners must be considered, such as their ability, level of maturity, peculiarities of their mental structures, habits, and skills.

These theoretical requirements set several criteria for projecting teaching strategies for the development of cognitive skills. For example, the idea of a necessary sequence in the development of cognitive skills implies first, that acquiring cognitive skills does not belong in the category of instantaneous learning which is characteristic of learning information such as an historical date or the fact that water freezes at zero temperature Centigrade. To learn either to modify a conceptual structure or to develop a model for inference requires both a time span and active practice. The assignment of learning tasks and the expectations should be governed accordingly. In addition, the idea of cumulative sequence in the development of cognitive skills requires not only planning an upward spiral in the content, but also a spiraling in the demands regarding the level of cognitive functioning -- a greater degree of precision,

a higher level of abstraction, a more refined analysis, etc.

In addition, several cycles of sequences are involved. The major cycle follows the rotation in which simpler and more concrete operations precede the more complex and abstract ones. For example, a cycle of learning experiences for developing and using a basic idea or concept would consist of three steps: Initially, there should be opportunities for an analysis of the sampled concrete instances of the general ideas. These encounters with the specific instances of the general ideas should be frequent enough to permit an intuitive grasp of the idea. This analysis should then be followed by learning tasks which help the students to perform consciously that which they at first only did intuitively, such as the operations to discover and to make inferences. Finally, to assure that learning generates transfer, experiences are needed which call for the application of that which is learned to new events or situations.

A systematic rotation of tasks which enhance assimilation, or absorbing information into the current mental scheme, with those that require accomodation, which calls for a reorganization of that scheme, provides another cycle of sequences, but in a smaller compass. Pacing of the two becomes a special problem for teaching strategy. While students need a sufficient amount of assimilation to have "stuff" to think with, prolonged assimilation of facts without the corresponding reshaping of the conceptual schemes with which to organize them is bound to be boresome and to retard maturation of thought. On the other hand, a premature leap into a more complex or a higher level of thought is likely to immobilize mental activity and to cause reversion to rote learning, or at any rate to a lower level of thought. An appropriate transition from one to the other requires a proper match between the current level and that which is required (Hunt, 1961, Ch. 6). Determining this proper match is perhaps one of the most difficult tasks in teaching, and constitutes in effect a new concept of readiness and pacing. This task is complicated by the fact that the mastery of abstract communications, such as language and number, often masks the actual level of thinking. Verbalization may deceive the teacher and lead him to assume that thinking is more advanced than it is, and hence to pushing the child's verbal habits of learning beyond his level of thinking (Peel, 1960, pp. 64-65).

The strategy of rotating assimilation and accomodation is fundamentally different from "correcting" the student. The task of reorganization must fall on the student instead of being performed by the teacher, which is the case in correcting errors of thought on the spot, in place of providing experience which leads the student to self-correction. To the extent that the students are led to discover ideas and conceptual organizations on their own, they also acquire a progressively greater control over the information with which they deal.

It is possible, further, that the key to individual differences in learning may be found partially in the difference in the amount of concrete thinking an individual needs before formal thought can emerge. This difference may distinguish the slow but capable learner from one who is incapable of abstract thought. It is not beyond possibility that many a slow learner can achieve a high level of abstract thought, provided he has the opportunity to examine a greater number of concrete instances than the teaching process now allows. The employment of teaching strategies which are scientifically designed for the development of cognitive skills may make it possible to develop cognitive processes at a much higher level, and in a greater number of students.

In addition to these general considerations regarding teaching-learning strategies in the cognitive domain, special analysis was made of the learning sequences of the three cognitive tasks with which the study was concerned, and of the teaching strategies for guiding this learning.

Finally, there are sequences to be observed in developing the thought processes involved in the cognitive tasks, as described in Chapter II. Teachers must make decisions regarding the adaptation of the sequential steps required for a particular cognitive task to the possibilities of the group: how to pace each step or to combine certain processes, such as alternating specification and classification of information and generalizing; deciding when it is possible to shift the focus or to lift the level of thought, such as shifting from description ("what") to explanation ("why?"), and so on. Attempts to lift thought prematurely to a higher level may result either in confusion or regression to the more primitive level. Irrational or non-sequential tasks may involve demands on cognitive operation which are beyond the capacity of students to follow.

Decisions regarding pacing and progressive lifting of thought levels naturally depend upon accurate diagnosis of the group's level of performance. Depending upon both their ability and previous habits of thought, some groups require a more prolonged analysis of descriptive information before they can successfully deal with explanations, while others can do with less. Some students can readily grasp the idea that grouping must be done according to some definite basis, while others may need to "mess around" for a time to "discover" this idea. In some classrooms a great deal of clarification may be needed in order to hold them to a focus, while others may have no difficulty with staying on the focus of the task. In effect, then, a continual diagnosis of the degree of readiness for the next step and a continued testing of limits is needed.

Since the particular response patterns are bound to differ from class to class and even from individual to individual, the matter of pacing inevitably must be decided "on the spot," so to say. While the general principles of a sequence can be established beforehand, the particular pacing of the steps involved and the special ways of coping with the divergent student performances can only be determined "in the process." These "on the spot" decisions are aided by teachers' ability to get feedback from the students regarding their responses to them. This is the aspect of teaching which is usually described as "art," chiefly because neither the means nor the materials have been available to give teachers proper clinical experience with the process.

For teaching strategies to be adequate for the development of the cognitive skills described above, teachers must have two cognitive maps: that of the structure and the sequence of the process involved in the task, and that of the content. For example, in the task of enumerating and categorizing the differences one would expect to find in Latin America, the teacher needs to know what the important differences between the United States and Latin America are, in order to help students to an orderly conceptualization of these differences. In addition, he must understand the logic of grouping and classification, in order to distinguish statements which represent verbal stereotypes from those which are specific enough to permit adequate grouping; e.g., the distinction of "climate," which only denotes an area of possible differences, as against "seasons are backwards," which actually describes a difference. Understanding the different orders of classification is involved also, such as recognizing that categories such as "transportation," and "education," are different from generic categories such as "conditions and facilities," and that the mixing of the two will create confusion.

Consideration of the importance of autonomy in cognitive processes and of the "action" principle of developing cognitive structures suggests that distinguishing what a teacher needs to give and what he needs to seek is one important facet of teaching strategies. If the development of autonomy in thinking is an important objective, the "seeking" functions of teaching assume greater importance than those of "giving." For students to develop their conceptual structures by their own efforts and to master the methodology of doing so, the usual teacher's role must be reversed. Instead of being a fount of information he needs to become an adroit guide of the heuristic process.

The role of questions becomes crucial, and the way of asking questions far the more influential single teaching act. A focus set by the teacher's questions circumscribes the mental operations which students can perform, determines which points they can explore, and which modes of thought they learn. A question such as "what are the important cities in the Balkan?" provides a poor focus in several respects. Because no criterion of importance is available, such a question develops an unproductive mode of thinking, in addition to training in arbitrary judgment. Such a question suggests, first, that one can judge the importance of cities without a criterion. For example, does one look for large cities, capitals, ancient ones, or what? Most students faced with such a question have only two alternatives: guessing what the teacher wants, or trying to recollect what the book says of the topic, both cognitively not the most productive activities. Asking questions to which only one right answer is possible builds, in addition, a convergent mind -- one which looks for simple "right" answers and which assumes that the "right" answers depend on authority rather than on rational judgment.

The nature of questions a teacher asks also determines the degree to which heterogeneity of perception and of cognitive skills can be accomodated. To accomplish this, questions are needed which are openended and yet focused. An openended question is one which sets a focus that is perceptible to students and which permits spontaneity and participation in the search by students of different abilities by allowing individuals to respond in terms of their own perceptions instead of pursuing the line of thought and doing it on a level established by the teacher. For example, in interpreting new information such as a film, the first question might be an open one such as "What did you see?" Naturally, an anthropologist will see more in a film than do elementary school children. The cues he uses and the principles he can apply in seeing commonalities in apparently diverse bits of information are richer. But similar differences also exist in the range of cues and organizing principles used by different students in the same class. These cues define the latitude and depth of their perception, and the range of ideas they can bring to bear upon interpretation of what they see. The question "Which of these things stood out especially for you?" establishes a special, and a bit more confining, focus. Still, each student is free to express whatever stood out for him.

In a sense, then, a strategy of questions needs to combine an appropriate constraint with an appropriate degree of freedom. Questions can also be arranged to create stepping stones for transitions from one mode of thinking into another, or for the formation of new conceptual schemes and ways of thinking, such as providing transitions from the specific to the general, from the descriptive to the explanatory mode of thinking, or from the inductive process of formulating generalizations to the deductive one of using them in a new context. In such a case, a sequence of questions is needed, such as starting with the "what" or description, following with a "why" or an explanation, and then reaching for a generalization or a principle. Involved in such a sequence are questions which induce comparing and contrasting to sharpen differentiation and to organize the relevant detail in preparation for generalizing or inferring. The chief point about such a strategy of questions is to stimulate and to guide the direction of that search, instead of providing the particular model or even the end product.

The impact of teaching lies not alone in its single acts, but in the manner in which these acts are combined into a pattern; the particular combination of focusing, extending, and lifting; the length of time spent on a particular operation in preparation for another level; how the functions of "giving" and "seeking" are distributed; and the way in which the intake of information is alternated with processing, transforming, and synthesizing the information.

Finally, the requirements of the logic of the task are not the only ones in determining the total teaching strategy. The fact that teaching and learning occur in a group situation introduces the need for a host of so-called managerial functions. The teacher must do certain things to keep order in the discussion. He must recognize the limits between disorder and a control so great that it stifles expression. He must watch for opportunities to enlarge the students' participation, and not let the aggressive students absorb all the social space and opportunities for self-expression. In addition, there are functions which are necessary to establish the affective climate in the classroom. This involves management of students' ego needs, an awareness of the great varieties and degrees of these needs, and the creation of an atmosphere for a common and cooperative effort.

CHAPTER IV

TRAINING OF TEACHERS

The design of this research specified that the study be conducted under optimal conditions for training of students in cognitive processes. Two elements of these conditions were suggested. One was a curriculum organized to facilitate growth in thinking, which was already being followed in the classes in which the study was conducted. This curriculum employed an approach which combined the two usually separated considerations -- the demands of the logic and the structure of the subject matter, and the psychological approach to learning. The chief characteristics of the design of this curriculum were as follows: a) Its units were organized around basic ideas drawn from a variety of social sciences; b) Rather than attempting complete "coverage," it sampled the specific content by selecting appropriate contrasts necessary for students to discover these ideas. It provided room for a study in depth of these basic ideas, and for emphasizing training in important cognitive skills; and c) it included a planned sequence of learning experiences to assure both a spiral development of the basic concepts and ideas and a cumulative progression in cognitive skills (Contra Costa County Schools; Taba, 1962, Ch. 20).

The second element for "optimal" conditions was the ability of teachers to follow adequate teaching procedures in implementing the curriculum and in guiding the development of the three cognitive tasks on which the study was centered. To provide for this condition, special training of teachers was undertaken. The theoretical assumptions which guided this training have been discussed in the preceding chapter. This chapter describes the method and the manner of training.

The training group included twenty teachers, representing the twenty classrooms in the study, ranging from second to sixth grade levels. Of the ten days provided for training, five were used consecutively in August before the schools opened. The remaining five days were spent in half-day sessions throughout the year, which were scheduled at specific points where training was needed. These training sessions were conducted by the study staff and the three curriculum consultants of the Contra Costa County Schools who had been responsible for the development of the curriculum. One of these consultants was a part-time member of the research staff responsible for scheduling testing and taping, various other arrangements with the schools, and for the actual taping of the classroom discussions.

The training program was divided into two major areas:

I. The analysis of the structure and the rationale of the curriculum.

II. The training in the teaching strategies for the development of the skills involved in the three cognitive tasks.

I. THE STRUCTURE OF THE CURRICULUM

These discussions dealt with the chief elements of curriculum and the role these elements play in decisions about curriculum.

1. The sources for criteria for decisions about curriculum

This included an examination of such questions as what is important in the culture today, what learners are like, with what types of student population we deal, what we know about the learning process, and finally what the nature or structure of the social studies content should be.

2. The objectives

Four types of behavioral objectives were distinguished:

a. Knowledge, which consists of concepts, ideas, and facts, each of which serves a different function in the curriculum.

b. Attitudes, sensitivities, and feelings.

c. Thinking, which includes three types of processes: concept development, interpretation of data, inferences and generalizing, and application of principles.

d. Skills required by this type of curriculum, such as ability to select and organize pertinent data and competencies for productive group work.

Two points were emphasized: First, that the chief reason for this fourfold grouping of educational objectives was to distinguish the types of outcomes which involve different ways of learning. Each of the above areas of objectives requires a different strategy of learning and teaching, and one cannot assume that by mastering one, such as acquiring knowledge, students also learn to think and to acquire the necessary skills. Second, the objectives are essentially a platform for selecting and organizing content and learning experiences. The objective of knowledge, when spelled out, should yield the scope of content to be taught. This objective is, therefore, implemented through the selection and organization of the content. The remaining three areas of objectives -- attitudes, thinking, and skills, are largely implemented by the selection and organization of learning experiences. This view of the objectives was new to the teachers and difficult for them to understand realistically.

3. The selection and organization of content

The chief emphasis here was on the different functions served by the different levels of the structure of the content represented in the units: The concepts, which serve as cumulative threads to which return engagements are made throughout the program; the basic ideas which provide the organizing foci for the different units and represent the fundamentals to be understood by all students; and the specific information which is sampled rather than covered and serves as working material for the development of the basic ideas.

The fact was stressed also that these levels of knowledge offer different degrees of freedom for adaptation and modification to the nature of the students. Concepts are hierarchical, in the sense of representing different levels of abstraction. Students, therefore, may acquire them on different levels of insight and depth. Since concepts thread through the entire program, their modification by individual teachers is limited to altering the level at which they are mastered.

As fundamentals, the focal ideas are the common content for all students. The freedom in altering these ideas is greater, although an individual teacher probably could not muster the analysis required to modify their selection. This is a task for a team consisting of teachers, curriculum experts, and content specialists. The specific facts and concrete content represent the most flexible and adaptable level of knowledge. Since it is possible to develop the same idea through sampling a variety of specifics, teachers can be free to substitute new content samples, provided that these are equally appropriate to developing the main ideas.

The chief problem here was to counteract the usual concept of "coverage" which usually leads to overburdening the students' minds with disconnected descriptive detail. It was also difficult to convey the idea of sampling specific content, especially the possibility of substituting alternative samples of content whenever student backgrounds warranted it. Some attention was devoted to content analysis; namely, to identifying the ideas and concepts drawn from anthropology, economics, history, geography, political science, and sociology, that could serve as appropriate samples of content.

4. The structure and the sequence of learning experiences

The fact was stressed that all learning experiences must serve identifiable functions, and that nothing should be happening in a classroom which a teacher could not justify in terms of objectives. Some practice was provided for identifying these functions, and especially in exploring the ways in which a learning experience could serve multiple objectives. Of special importance was to create insight into the sequential nature of the development of thought, and consequently the need for sequentially ordered learning experiences, both in large and small cycles. The principle of rotating assimilation and accomodation, the role of contrasting and comparing as a means for sharpening generalizing, was stressed. An effort was made to help these teachers translate these principles into teaching strategies, such as rotating the intake and expressive experiences, and alternating the study of concrete facts with generalizing from them. This latter emphasis was especially needed because the usual preference and habit of teachers inclines them to elaborate descriptive information at the expense of data processing -- an imbalance which tends to cultivate passive learning and under-expose students to active cognitive operations.

The study of the general rationale for the selection and organization of learning experiences was followed by a closer study of the ways of adapting learning activities to the particular levels of maturity and ability of the students. Ways were worked out also for setting the expectations for such tasks as composing time lines, developing classification schemes, and interpreting maps in an ascending order of precision and complexity demanded on different levels of maturity and the amount of previous experience.

Special sessions were devoted to the strategy of conducting openended discussions. The strategies were differentiated according to the functions which these discussions served, as follows:

1. Discussion patterns in which getting a census of problems, ideas or feelings is the chief focus, or which serve primarily to ventilate reactions to an incident or a story. These types of discussions require few controls beyond the managerial ones to preserve spontaneity and to assure the widest possible participation.

2. Discussion, the chief task of which is to exchange and to consolidate information secured during a period of intake, such as a period of reading, an observation trip, or committee work. The processes in this type of discussion need to be sufficiently controlled to assure clarity of communication, an orderly assembly and processing of descriptive information and of generalizing.

3. Discussions in which the development of an idea or the discovery of a mode of thinking is the primary focus. This type of discussion is the most difficult to conduct, as it requires openendedness regarding the content and a fairly strict order in procedure, to protect an inductive discovery in the development and application of ideas.

II. TRAINING IN TEACHING COGNITIVE SKILLS

The ten half-day training sessions distributed throughout the school year were devoted primarily to elaborating the theory and structure of the three cognitive tasks -- grouping and classification, interpretation and inferences, and application of principles -- and the strategies necessary for developing the skills involved.

1. Training tasks

In a way, these training sessions were addressed to the task of remodeling two sets of cognitive maps: one concerning the content and the other concerning the nature of the thought processes emphasized in the study.

The cognitive map of the content of thought is important in guiding thought in relevant directions, such as making distinctions between inferences that are significant and those that are trivial. Such a cognitive map is especially needed in guiding the process of hypothesizing and predicting, such as predicting what will happen in a desert if it should have all the water it needed. This type of task stimulates a high degree of divergence of predictions. If reasonable constraint is to be exercised in these predictions, they must at the same time be examined in the light of relevant parameters of information and logic of conditions. Since these operations do not occur in an orderly sequence, diagnosing what goes on and protecting creativity and autonomy of thinking and the logic of content at the same time becomes a complex task which taxes the teacher's understanding of both the process and the significant dimensions of the content. The teacher needs, for example, to be able to discern the significance of a prediction in order to decide the points at which clarification is needed, where questionable assumptions or invalid information is involved, etc. As long as teachers cannot distinguish between relevant possibilities and irrelevant ones, it is difficult for them to guide the discussion along productive lines.

Deficiencies in the cognitive map of the teacher are apt to create special difficulties in dealing with events involving abstractions. For example, in comparing the ways of financing the expeditions of Columbus and the currently planned expeditions to the moon, the question regarding who did the financing was answered, respectively, "The King and Queen of Spain," and "Us." Neither the teacher nor the class realized that in both cases it was "us" in the sense of "people through the government."

Neither saw that in both cases government was doing the financing, although in a different way.

In cultivating thought processes, teachers needed to be able to focus on the active exercise of the process, instead of attempting to convey the eventual product. For example, in connection with grouping and classification, it was necessary to free teachers of the tendency to teach a particular classification which they thought was the only "right" one and thus, in effect, teach schemes of classification instead of the process of classifying.

The cognitive map of the thought processes involved first the understanding of the sequential steps in mastering thought processes involved in the three cognitive tasks. Teachers needed also to understand the implications of the levels of maturity of the students for the nature of the operations expected of them. For example, since there are variations in the natural basis for grouping and labeling, depending on age and maturity, a functional classification such as grouping peaches and ice cream together, since they are eaten together, may be appropriate for a second grader, while a third grader may be expected to group the same items by classes of foods, such as vegetables and fruits. As skills and maturity increase, students may be able to explore multiple bases for classifying. For example, "food" can be classified as a "product" or as "standard of living," depending on whether the focus is on what is produced and processed, or on the quality and abundance of food. Teachers also needed to become sensitive to the fact that students often use terms the meaning of which they do not fully understand, such as using a label without knowing what "belonged to a label" or how that which belonged was related to something else, i.e. how climate, weather, and altitude are related.

This tendency to use verbal symbols without precise meaning is a special hazard in social studies, because in this field there is a scarcity of concrete referents for abstract verbal symbols. Consequently, unless assiduously planned, the opportunities for converting verbal abstractions into either visual or operational equivalents are scarce. Seemingly, the higher the IQ, the greater the danger that meaningless verbalism is used so convincingly as to fool the teacher into believing that the thinking is more advanced than it is, and hence to pushing the child's verbal habits of learning beyond his level of thinking.

Especially needed was understanding that in discussions of the role of specific information devoted to the development of cognitive skills, an overelaboration of detailed information may actually be of detriment, because it tends to deflect the students from the proper focus. For example, a long recital or debate about where a certain explorer broke his leg, in the middle of an attempt to line up what the class knows about early California, may distract students from the task of grouping their information and thus also prevent them from carrying on the cycle of processes needed to learn to classify information.

This eagerness to extend "covering specific information" and to extend specific answers is an especially difficult behavior to change, because teachers are conditioned to consider themselves conveyors of information and answer-givers, and therefore have a disposition toward favoring information whether it is relevant or not, and whether or not it helps the operations of thought.

Teachers also needed to learn to accept the apparent slowness of the process of inductive development of ideas by this method, in comparison to expository teaching in which ideas are acquired by the teacher stating the generalization and then asking for concrete illustrations. As long as the expectations of teachers are focused on the final answers, rather than on the evolving thought, the pacing required to develop the appropriate skills and thought forms seems intolerably slow, if not unproductive. To a teacher anxious about answers, such preparatory activities as the listing of specific points seen in a film, before launching into explanations and interpretation of what was seen, seem a sheer waste of time, because such activity is not warranted by the content produced.

At these points there is great temptation to supply what is needed -- a generalization, a basis for grouping, or a condition for prediction, instead of formulating questions designed to elicit from the students the appropriate considerations or relationships. When teachers supply what they should seek from the students, they substitute their own thinking for that of the students, and consequently control thought and limit the opportunities for autonomy and self-discovery.

Finally, the training sessions dealt with the ways of organizing a class for productive group work, such as how to compose committees, how to organize a class for working in groups, and how to pace the work of a committee. These matters are especially relevant if the work of committees is to eventuate, not in a series of reports, but in discussions of the common study questions to which each committee supplies whatever it has that is relevant, and from which each derives new material for generalizing and synthesizing.

2. The method of training

There is no use in pretending that ten days of training can transform teachers into perfect masters of such complexities. These are skills which take both time and practice to become an adequate tool chest. Some of these strategies involve transformations of personal dispositions and of habits of long standing and, therefore, require more sophisticated methods and materials of training than is usually possible to provide. However, it was evident that even ten days can make a marked impact on the methods of teaching, provided that the training fulfils at least the following three conditions: gives a reasonable explanation of the theory underlying the strategy, in terms which teachers can understand; presents an opportunity to mobilize self-learning by providing feedback on their own attempts at these strategies; and provides concrete models.

The training methods used attempted to fulfil these conditions. The work on each cognitive task involved at least three steps, accomplished in two or three sessions. First there was a presentation of the structure of the process and of the progressive steps involved in mastering it. This presentation was accompanied by such illustrations as were available. The second step consisted of a "scoring" of one tapescript of a discussion involving the task in question, followed by an analysis of the particular patterns by which the discussion was managed, what successes were evident, what errors were committed, and what the consequences of these errors were. Third, each teacher received the tapescript of discussions he had held with his own class, with an assignment to analyze it on his own for successes, errors, and problems.

Throughout, specific examples of closed classroom discussions were examined for contrast. For example, the excerpts from Marie Hughes's study illustrating the control exercised by teachers were distributed and studied (Hughes, 1959).

While, for lack of staff time, no systematic records were kept of teacher reactions to these training devices, it seemed that the greatest progress toward understanding what was involved occurred at the point of feedback; that is, when the teachers were able not only to examine someone else's discussions as models, but also had the tools and criteria by which to evaluate their own tapescripts. For different teachers, the moment of insight occurred at a different point in the training. This suggests that an ideal design for assessing the results of training in as complex a set of concepts and skills as were described above, is to provide training and practice in one year, and to assess the results in the subsequent year.

CHAPTER V

CHARACTERISTICS OF THE SAMPLE

Four criteria were used for selecting the classrooms in the study. First, it was important to have as even a distribution of classrooms on each grade level as was possible to secure. Second, an attempt was made to obtain a fair range of ability. For example, among school systems in which ability grouping was practiced, the lowest as well as the highest ability groups were chosen. Third, an attempt was made to span the range of socio-economic status of the school community and to sample different types of communities - suburban, industrial and agricultural. Fourth, an effort was made to select teachers who were flexible enough to be able to benefit from the training, who had indicated some concern or interest about their teaching, and who therefore had some motivation to change their teaching strategies. Otherwise no attention was paid to the type of their training, length of tenure, or experience.

These criteria were applied according to the judgment of the three county curriculum coordinators who had worked in these schools fairly intimately for several years. No special data were used to draw the sample. However, as the data accumulated during the study indicated, these judgments turned out to be fairly valid.

By applying four criteria, it was impossible to secure an ideal distribution on any one criterion. For example, the number of classrooms which were estimated to be the lowest sections in the ability-grouped schools exceeded those which were estimated to be the highest. Similarly, the low income areas were represented more frequently than were the high income ones.

TEACHERS

Since training of teachers was involved and since, furthermore, the time available for the training was brief, it was important to select teachers with maximum motivation, a reasonable flexibility and a capacity to learn and to change their teaching style. The application of the criteria of interest and flexibility yielded teachers with a great variation in age, experience, content background, and intellectual capacity, but with a fair homogeneity of attitude toward their job, children, and curriculum. Seven of the twenty teachers had been involved in the development or the field trial of the curriculum outlines they were using. The range in experience was wide; one teacher was in the second year of teaching, while another was within one year of retirement. As is usual for the elementary teachers, all but two were women. This method of selection also produced a group of teachers who represented a great variety in their capacity to assimilate the training and to acquire the skills necessary for conducting an ideal classroom. With this group of teachers there was no problem with reluctance to apply whatever was learned in the training sessions, nor was there a problem of hidden non-acceptance of the style of curriculum represented in the outlines which the experimental classrooms followed.

THE SCHOOL ATMOSPHERE

The atmosphere in all classrooms in the study was fairly adequate for productive learning. The teachers had freedom to plan and manage their classrooms as they thought wise. The principals were in sympathy with the spirit of the curriculum, were interested in the study, and highly cooperative in providing and facilitating taping and testing. Adjustment problems of the children received special attention, and none of the teachers showed punitiveness toward their least achieving and their most troublesome students. Evidently, the criterion of finding situations congenial to learning and to treatment of heterogeneity had been applied quite successfully.

THE STUDENTS

The sample in the study consisted of twenty elementary classes, distributed in sixteen different schools in nine different school districts in Contra Costa County, as shown in Table 1.

Ethnically, the sample is largely Caucasian. Four classrooms contained a considerable number of Spanish speaking Mexican children. Two classes contained Negroes. The exact number of these was not ascertained.

TABLE 1

Distribution of Sample by Grade, School, and Number of Districts

Grade Level	No. Subjects	No. of Classes	No. Schools	No. Sch.Dists.
2nd	83	3	2	2
3rd	129	5	4	4
4th	58	3	3	2
5th	116	5	5	3
6th	95	4	4	4
TOTALS	481	20	16	9

Initially, the total number of students was 590 -- 279 females and 311 males. However, the actual number of students involved in the beginning differed from the number on which data are reported. Through attrition, including transfers and students on whom it was impossible to secure all data, the final number of students was reduced to 481 -- 228 females and 253 males, as shown in Table 2. In the analysis of the tapescripts, this figure was further reduced slightly, due to absences of a few children on the days of taping the discussions.

TABLE 2

NUMBER OF CHILDREN IN THE INITIAL AND FINAL SAMPLE AND THE AMOUNT OF DECREASE

Class	Initial Sample	Final Sample	Decrease
Second grades			
21	32	29	3
22	30	29	1
23	27	25	2
TOTAL	89	83	6
Third grades			
31	34	22	12
32	33	23	10
33	35	32	3
34	35	32	3
35	27	20	7
TOTAL	164	129	35
Fourth grades			
41	26	16	10
42	28	23	5
43	23	19	4
TOTAL	77	58	19
Fifth grades			
51	31	26	5
52	29	26	3
53	26	21	5
54	26	19	7
55	31	24	7
TOTAL	143	116	27
Sixth grades			
61	23	21	2
62	31	25	6
63	29	23	6
64	34	26	8
TOTAL	117	95	22
TOTAL	590	481	109

The comparison of the means and standard deviations on the initial and the final sample showed a very small difference between the two groups in all the basic data reported.

CHARACTERISTICS OF THE SAMPLE

Information on the ability level of the children in the study was obtained from school records. The ability tests administered to the children at the various grade levels are listed below:

2nd grades	N = 83	Lorge-Thorndike
3rd grades	N = 97	California Test of Mental Maturity
	N = 32	Henman-Nelson
4th grades	N = 40	Lorge-Thorndike
	N = 15	SRA
	N = 1 each	California Test of Mental Maturity, Otis, WISC
5th grades	N = 44	California Test of Mental Maturity
	N = 20	SRA
	N = 52	SCAT
6th grades	N = 47	California Test of Mental Maturity
	N = 21	SRA
	N = 26	SCAT
	N = 1	Henman - Nelson

All intelligence scores were converted to mental ages and IQs in order to obtain a common base line for across-grade comparisons.

Table 3 presents descriptive data on the children in each class in the study. These data indicate a considerable range of mental ability, not only in the total group, but also in the grade level samples as well as in the class groups. Only four class groups showed a mean IQ below 100, and even in these, the range of IQ was considerable, and all class groups, with the exception of one, include a number of students with IQ's considerably below 100.

TABLE 3 SAMPLE DESCRIPTION

		Chronological Age (Yrs-Mos)		IQ Scores		Grade Placement Scores Reading		Grade Placement Scores Social Studies		Socio-Economic Status Percentage			
Class	N	M	Range	M	Range	M	Range	M	Range	I	II	III	N/D
21	29	7-7	6-9 to 9-10	102	60-136	2.3	1.5 to 3.7			13	44	34	7
22	29	7-5	6-8 to 8-8	110	71-160	2.7	1.5 to 3.9			7	69	24	
23	25	7-5	6-11 to 7-10	112	89-136	2.5	1.6 to 3.7			12	84	4	
Total	83	7-6	6-8 to 9-10	108	60-160	2.5	1.5 to 3.9			11	65	22	2
31	22	8-7	7-11 to 9-1	107	86-121	3.0	1.9 to 4.9				82	14	4
32	23	8-5	7-11 to 9-5	109	86-134	2.5	1.2 to 4.4				73	23	4
33	32	8-3	7-9 to 8-10	112	79-139	3.6	1.3 to 6.4			19	78	3	
34	32	8-3	7-9 to 9-0	120	100-141	4.2	2.2 to 6.0				71	25	3
35	20	8-6	7-10 to 9-5	106	83-120	4.2	3.3 to 5.5				55	45	
Total	129	8-4	7-9 to 9-5	111	79-141	2.9	1.2 to 6.4			5	72	21	2
41	16	9-5	7-11 to 10-8	112	77-144	5.2	1.9 to 7.9	5.2	3.0 to 9.2	25	50	25	
42	23	9-6	8-11 to 10-9	94	64-114	3.3	1.3 to 5.5	3.6	3.0 to 5.5	13	70	13	4
43	19	9-6	9-1 to 10-0	98	64-129	4.0	2.4 to 6.6	4.6	3.0 to 7.0	21	79		
Total	58	9-6	7-11 to 10-9	100	64-144	4.0	1.3 to 7.9	4.4	3.0 to 9.2	19	67	12	2
51	26	10-5	9-10 to 11-3	112	78-134	7.2	3.7 to 9.9	7.5	3.8 to 9.9	27	69	4	
52	26	10-6	10-0 to 11-5	112	77-133	7.5	3.1 to 9.9	7.5	3.0 to 9.9	23	61	8	8
53	21	10-9	10-0 to 11-8	88	61-107	5.5	3.4 to 8.7	5.9	3.0 to 9.9	14	81	5	
54	19	10-7	10-0 to 12-9	104	86-125	5.6	3.5 to 6.9	5.6	3.3 to 9.6		68	32	
55	24	10-6	9-11 to 11-11	96	59-121	5.1	3.0 to 6.7	4.1	3.0 to 6.4		54	46	
Total	116	10-6	9-10 to 12-9	103	59-134	6.3	3.0 to 9.9	6.2	3.0 to 9.9	14	66	18	2
61	21	11-4	10-9 to 12-6	103	50-132	6.9	4.4 to 9.7	6.9	4.3 to 9.9		76	14	10
62	25	11-4	10-9 to 11-9	118	99-141	8.9	6.3 to 9.9	8.7	6.4 to 9.9	4	84	12	
63	23	11-3	10-8 to 11-8	121	85-146	8.7	6.6 to 9.9	8.8	6.6 to 9.9	39	52		9
64	26	11-6	11-1 to 12-0	96	81-111	6.8	4.1 to 9.9	8.7	6.8 to 9.9	23	73	4	
Total	95	11-4	10-8 to 12-6	110	50-146	7.8	4.1 to 9.9	8.3	4.3 to 9.9	17	72	7	4
Total All Grades	481	9-5	6-8 to 12-9	107	50-160	4.8	1.2 to 9.9	6.6	3.0 to 9.9	12	69	17	2

The tests of reading achievement administered at the various grade levels are as follows:

2nd Grade	N = 83	Metropolitan Achievement Tests
3rd Grade	N = 65	Metropolitan Achievement Test
	N = 32	Science Research Associates Test
	N = 32	California Achievement Test
4th Grade	N = 39	Metropolitan Achievement Test
	N = 18	Science Research Associates Test
	N = 1	Standford Achievement Test
5th Grade	N = 52	STEP Tests
	N = 43	California Achievement Test
	N = 20	Science Research Associates Test
	N = 1	Metropolitan Achievement Test
6th Grade	N = 51	California Achievement Test
	N = 23	Metropolitan Achievement Test
	N = 21	Science Research Associates Test

All achievement test scores were converted to grade level placement scores in order to make possible the comparison of scores.

Reading achievement tends to be above the grade level norms. The mean score on reading exceeds the grade placement norm in sixteen of the grade groups, is at the norm in 2 and below it in 2. The level of reading represented on each grade level is quite varied, ranging from two years to six years distance from the lowest to the highest. A range of three years appears with the greatest frequency. In seven of the grades the reading range spans from five to six years. This range tends to increase on higher grade levels, although some fairly wide discrepancies occur as early as the third grade, in which some students show only the first grade reading ability, while others perform on the sixth grade level. The four classes with the lowest and the four with the highest mean IQ have similar spans in reading ability.

Data on achievement in social studies were secured from the STEP Test, the only achievement test administered specifically for the study.

Achievement in Social Studies is even more markedly above the grade norms than reading, especially so in the sixth grade where the mean score is two years and three months beyond the grade norm. This high achievement is shown even in classes with low mean IQ's such as 53 and 64.

SOCIO-ECONOMIC STATUS

The socio-economic status of the individuals was secured by ascertaining the occupation of the father and then converting these data into socio-economic status placements. The revised Warner Scale* was used and the status differentiation was modified by grouping into three groups instead of seven Warner Scale groupings. This grouping was made as follows:

	Warner Levels
Category I	1, 2
Category II	3, 4, 5
Category III	6, 7

This grouping seemed more in keeping with the fact that only one criterion, the employment of the father, was used.

The socio-economic levels are distributed fairly evenly, with perhaps a larger proportion of the upper class backgrounds than is generally the case in public schools (using the Warner percentages). Seven classes contain no students classifiable as upper class. There is a smaller proportion of lower class children than would probably be true in urban centers. Only four classes contain more than a third of lower socio-economic status children and only two classes contain no students classifiable as lower class. Considerably more than half of the students are the middle socio-economic level in all classes except three. This indicates that all classes in the study contained students of heterogeneous socio-economic status.

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* Reported in Research Memorandum, Report No. 3 on the Chicago Tribune Sample Census. February 1956.

CHAPTER VI

THE SOCIAL STUDIES INFERENCE TEST

MODEL FOR THE DEVELOPMENT OF THE TEST

To date, only one model has been developed to assess children's ability to interpret data and to draw inferences from them. This model includes both the inductive and deductive aspects of thinking because, as Smith and Tyler (1942) point out, it is neither necessary nor desirable that such a distinction be made in the process of evaluating and interpreting data. Smith and Tyler indicate that two important behaviors are involved in interpreting data: 1) the ability to perceive relationships in data and 2) the ability to recognize the limitations of data.

The Social Studies Inference Test is designed to measure several aspects of the process involved in drawing inferences from data which are new to the students. Contained within the test are several subtests which yield scores on the following:

a. the ability to discriminate between the various items given in the test problem

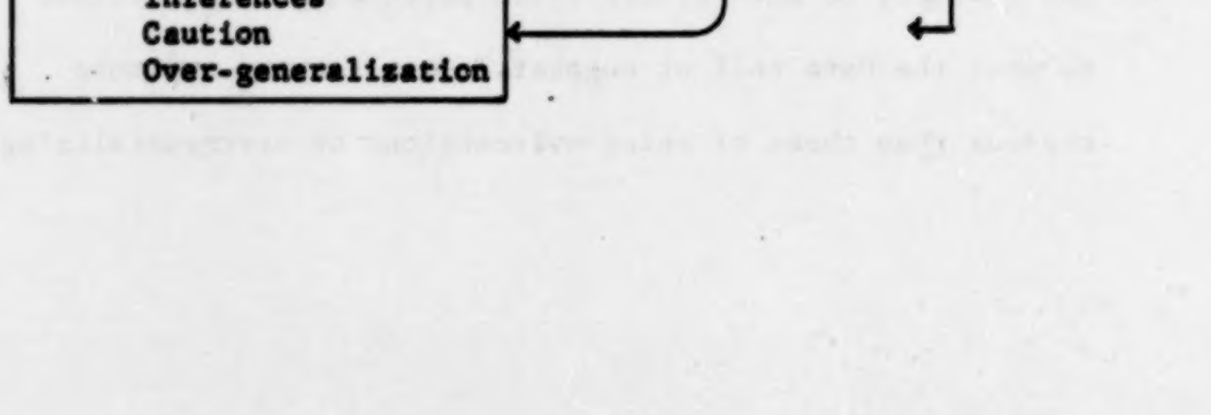
b. the ability to draw inferences or "to go beyond that which is given"

c. the ability to recognize the limits of the data and to refrain from overgeneralizing or from being over-cautious

d. the tendency to make errors which represent contradictions to what the data tell or suggest. These errors are more serious than those of being overcautious or overgeneralizing.

This test assesses the student's ability to interpret what is given in a situation and to make judgments regarding the validity of inferences from these data. The student is presented with a story describing a situation in which certain behaviors or events are interrelated. Below the story the student is presented a number of choices which are inferences varying in their degree of plausibility or probability of occurence. The inferences are the test items and are predicated on generalizations around which the situations are written. In effect, the descriptive stories presented contain information that permits the child to select "valid" inferences if he knows or understands the basic generalization of which the data are specific instances.

The Social Science Inference Test provides an indirect test of the individual's ability to generalize. For example, having formed the generalization that occupations follow family lines in non-literate societies, the student should be able to make inferences about all males in a particular family or predict the occupation of unborn males of a particular family. Schematically, the model for the Social Studies Inference Test is as follows:



THE STRUCTURE OF THE TEST

The Social Science Inference Test is designed to yield four scores: Discrimination (D), Inference (I), Caution (C), and Over-generalization (OG).* The test includes ten situations with a total of 68 items: 14 Discrimination items, 18 Over-generalization items, and 36 items scored as either Inference or Caution, depending upon how the item was marked. The student marks the items by indicating whether he believes a statement to be probably true, probably false, or that the data are equivocal and there is no way of determining whether the statement is likely to be true or false. Thus, the student has the choice of responding to each statement by marking it as "Probably True," "Probably False," or "Can't Tell."

In order to make a correct inference the child must discriminate the particulars in a given situation and by the process of abstraction inductively arrive at the concepts and generalizations around which the situations are written. He must also be able to relate points in the test situation to each other and make appropriate comparisons either in the form of extrapolation or interpolation. Finally, he needs to make judgments about the limits of data.

DISCRIMINATION SCORE Some items are designed to tap the student's ability to discriminate. Discrimination has to do with distinguishing one event or object from another. In this test discrimination includes the recognition of facts and ideas presented in a situation. This process is akin to distinguishing between relevant and irrelevant data, relevance always being determined within the context of a given situation. For example, the age of the child in a situation may or may not be relevant depending on whether age is related to concepts critical to making particular inferences. In a society where reading and writing are not stressed the fact that the child is beyond "school age" has little bearing on concepts dealing with literacy. However, in a society where the individual's competence is primarily expressed in symbolic form, concepts dealing with literacy are central to judging competency. In such a society the individual interpreting data will look for criteria relevant to literacy, age being one of these. Discrimination thus aids in the process of abstraction, the latter being critical to generalization. Once the individual has abstracted the essentials of the situation he can then interrelate the concepts so formed, and use them to arrive at generalizations.

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* Some aspects of interpretation of data included in these tests are similar to those included in the Eight-Year-Study and reported in Smith and Tyler (1942).

It would be expected that individuals who are good data discriminators, in the sense just discussed, would be better at judging the plausibility of an inference than poor data discriminators. Further, the individual who is a good data discriminator would be less likely to be cautious in making inferences than the poor data discriminator. That is, there would be a negative relationship between the Discrimination test scores and the Overcaution test scores. Discrimination is required in order for the student to abstract the essential elements given in a situation.

Because the Discrimination items assess the child's ability to determine what is presented in the situation, his score for a particular item will either be accurate or error. That is, either the child assesses correctly what is given in the situation or he does not. These items are not of the recall type. They require some interpretation, although they are not classified as inferences. The discrimination items restate what is given rather than go beyond what is given in the situation. The student is to respond to each item by choosing either "Probably True," "Probably False," or "Can't Tell." For the items only one of these choices will be correct, the other two being considered as errors. The Discrimination score is the sum of correct responses for these items.

INFERENCE SCORE The Inference score is a measure of ability to make inferences from data including the logical operations of interpolating, extrapolating, predicting, hypothesizing, and explaining. In interpreting data the student is required to make inferences in regard to a) how he or another individual is likely to behave under given circumstances, b) whether an event will or will not occur, and c) whether an event is responsible for the occurance of another event. For a given inference only one of the alternatives, "Probably True," "Probably False," or "Can't Tell" is correct. The sum of the correct alternatives for the inference items is the Inference score.

CAUTION SCORE Where the nature of the data is such that the most plausible answer is either "Probably True" or "Probably False" and the subject selects "Can't Tell" he is to be considered cautious. The probabilistic nature of any inference permits the student to select "Can't Tell." However, many of the items are of such a nature that an inference from the data can be defended either on deductive grounds or as a reasonable prediction from the data. Caution appears to be related to an individual's personalistic "style" of approaching data. It represents a tendency to avoid taking a risk. A fair discriminator may be overcautious if he has learned this "style" or is afraid of going beyond that which is given.

OVER-GENERALIZATION SCORE The most prevalent types of overgeneralizations in the social sciences are over-inclusion and stereotyping. Stereotyping is usually involved when people or some aspect of human behavior is the referrent. Vinacke (1949) states that stereotyping occurs when there is "a tendency to attribute generalized and simplified characteristics to a group of people in the form of verbal label." McDonald (1959, p. 157) points out that "Stereotypes are developed because the individual does not think critically, does not observe, does not analyze." That is, the individual has formed concepts based on inadequate experience and, therefore, he categorizes indiscriminately.

The individual who over-generalizes uses little empirical data; he arrives at conclusions with minimal evidence. His prior set(s) tend to dominate the data and, therefore, he would be a poor data discriminator. An over-generalizer may be an individual who discriminates well, but has a set to go beyond that which is given.

EXAMPLE OF A TEST SITUATION

An example of one situation in the Social Science Inference Test and the kind of test scores that are derived is presented below:

PAMBO AND TOM

Pambo is twelve years old. There are no schools where Pambo lives. He does not read or write. He fishes with his father every day. Pambo is learning to cut bark from trees in order to make a canoe. His father teaches him many things and is proud of how well Pambo can do them.

Tom is also twelve years old. He works hard at school and gets good grades. When he comes home from school he reads his books so that he will learn things that will help him.

The basic generalization around which the Pambo and Tom situation is written is: Many activities of primitive people are carried on through the family and/or tribe, whereas, modern communities provide for these activities through organized institutions. From this, it is possible to make deductions about family structure, how learning occurs (practical versus vicarious experiences), and occupational choice.

Item 17 Tom is smarter than Pambo

This item is designed to determine whether the child will accept the over-generalization. If he indicates that the inference is probably true, it seems clear that he does not recognize that in some cultures reading and writing are not essential and hence not valued. The student has not formed an adequate concept of the diversity of cultural demand in regard to the kind of competence required. In so far as the child over-generalizes about all cultures or societies having schools that stress reading and writing, he will also stereotype all people who cannot read and write as stupid. His thinking may be characterized as follows:

Premise: All children after a certain age go to school.

Premise: Most children who go to school learn to read and write.

Conclusion: If a child does not know how to read and write and is of school age, he must be stupid (intellectually dull).

Item 18. Pambo's father can read and write.

Considering the fact that there are no schools in this society and that his child cannot read and write, the most likely inference is that the father, too, cannot read and write. The manner in which the father pursues his occupation and the things he teaches his son would all point to this society as primitive. If the child selects

"Probably False" his response is accurate and he obtains one point on Inference; if he selects "Probably True" his response is considered as an error; if he selects "Can't Tell" his response is considered cautious and he obtains one point on Caution.

Item 22. Tom reads every day because he is behind in his school work.

This item contradicts the data which indicates that Tom gets good grades. The item is a restatement of what is given in the situation and is, therefore, a discrimination item. If the child selects either "Probably True," or "Can't Tell" his response is considered as an error. If he responds by marking "Probably False" he is given one point on Discrimination.

TEST DEVELOPMENT PROCEDURES

In order to develop the test items, a number of situations or stories were written around a sample of generalizations for each grade level from two through six. The test items (inferences) to which the students were to respond, after having read the story, were written so as to provide four scores: Inference (I), Discrimination (D), Caution (C), and Over-generalization (OG). The situations and inferences (test items) were reviewed by subject matter supervisors of grade levels in which the generalizations were taught, as well as by members of the faculty of San Francisco State College who train teachers in social studies. This procedure aided in clarifying the stories, provided a check on vocabulary level and the adequacy of the story to elicit the required generalization. Inferences were reviewed in order to determine the justification for scoring a response as either Inference, Discrimination, Caution, or Over-generalization. Inferences that could not be defended in terms of the rationale of the particular score to which it should contribute were eliminated. The situations and test items were then pre-tested, both in group testing and in individual testing.

(a) Group testing - The situation was administered to a group of older subjects who had completed the grades to which the generalizations apply. This procedure was helpful in weeding out ambiguous, irrelevant, and overly difficult items.

(b) Individual testing - At various stages in the initial development of the test, individual children were asked to respond to the situations. They read the situations out loud and judged each inference as Probably True, Probably False, or Can't Tell. They were then asked to give a rationale for the answer they selected. This entire procedure was tape recorded and provided a check on the ease of readability, vocabulary level, and whether children provide appropriate generalizations for explaining their choices. The children selected for this procedure were of both sexes and at various levels of intelligence.

Test situations and items were re-written, added, or deleted as indicated by the results of the above procedure.

The initial form of the Social Studies Inference Test included ten situations or stories and 94 test items (53 items scored either Inference or Caution, 20 items scored Discrimination, and 21 items scored Over-generalization.) This initial form of the test was administered to all children included in the study in grades four through six. A shortened version of this test consisting of the first five situations was administered to the third grades. In all revisions of the test the third grades took only the first 5 situations. This third grade test consisted of 40 items (21 Inference and Caution items, 11 Discrimination items, and 8 Over-generalization items.)

Based upon an item analysis and the intercorrelations of the items of the various scales, certain items which were not contributing to the scales or which were ambiguous, were deleted. The Social Studies Inference Test was then re-scored using this revised form of the test.* This revised test for grades four through six consisted of the same ten situations or stories, but now contained only 68 items (36 Inference and Caution items, 14 Discrimination items, and 18 Over-generalization items.)

The final form of the Social Studies Inference Test that was rescored for the third grades consisted of the same five situations and 27 test items (13 Inference and Caution items, 7 Discrimination items, and 7 Over-generalization items.)

Because this test was to be administered both at the beginning and end of the school year, it was necessary that identical versions of the test be administered at both of those times. Consequently, the original form of the test was given to the children at both time points, although, for scoring purposes, the revised scale was used. This meant that, because some items were to be deleted in the final form of the test, the children answered some questions that were not scored.

The Ease Index and Discrimination Index were determined for each item in the test and are presented in Appendix B. These indices indicate the difficulty level of the various items as well as the degree to which they discriminate between the upper and lower third of the scores.

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* A copy of this final form of the test with the scoring key for the various scales is included in Appendix A.

PROPERTIES OF THE TEST

THE TEST RELIABILITY

1. Internal Consistency

In general, the test has fairly adequate reliability. For grades four through six, where the total test was taken, the reliability coefficients (odd-even) ranged from a low of .63 for Over-generalization to a high of .90 for Caution. The internal consistency of the various tests at the fifth and sixth grade levels were consistently higher than the fourth grade.

The reliability coefficients for the third grade were generally lower than for the other grades, ranging from .32 for the Discrimination scores to .84 for the Caution scores. The fact that the third grade children took a shortened form of the test accounts, at least in part, for the lower reliability coefficients. These reliability coefficients are presented in Table 4.

2. Relationship Between Inference Scores and Teacher's Judgment of Inference

During one of the training sessions for teachers, they were asked to judge their children's ability to make inferences on social studies content as observed in classroom discussions and in assignments. The teachers were given the definition of inference that was used in the development of the Social Studies Inference Test. They were asked to divide their classes into thirds and judge a child as either high, middle, or low on inference. The teachers' judgments were then

TABLE NO. 4

ODD-EVEN RELIABILITY COEFFICIENTS* FOR SOCIAL STUDIES INFERENCE PRE-TEST SCORES

(Pearson Product Moment Coefficients)

(Total N = 398)

Grade	N	I	D	C	OG
3	129	.61	.32	.84	.58
4	58	.64	.63	.66	.63
5	116	.85	.72	.90	.77
6	95	.87	.68	.89	.71
4,5,6	398	.85	.72	.86	.73

All correlations corrected by the Spearman-Brown formula.

*All correlations $P < .01$

correlated with the children's post test scores in the Inference Test. These correlations are reported in Table 5.

The range of these correlations within grade level is large. For example, within the third grade level the range was from -.32 to 51 and for the fifth grade from .15 to .73. It is also interesting to note that within the fifth grade three of the five correlations exceeded .60, whereas two of the correlations were approximately .20. Were all of the correlations of zero order, one would be concerned with the validity of the Inference Test, assuming that the teacher's judgment is an adequate external criterion. However, the fact that some of the coefficients are rather respectable indicates that to some degree, the test is measuring something observable by the teacher and that some

TABLE NO. 5

GAMMA CORRELATION COEFFICIENTS[1] BETWEEN TEACHER'S JUDGMENT OF CHILDREN'S ABILITY TO MAKE INFERENCES AND SOCIAL STUDIES INFERENCE POST TEST SCORES

Teacher	Grade							
	N	3rd	N	4th	N	5th	N	6th
A	22	.33	16	.63*	27	.73*	21	.00
B	23	.51	23	.29	26	.22	25	.29
C	32	.26	20	.27	21	.64*	27	.28
D	31	-.32			20	.60*	28	.38
E	20	-.15			25	.15		

* $P < .05$

teachers are better judges than others. Because of the wide range in these correlations, the use of such judgments as an external criterion is questionable.

INTERCORRELATIONS OF SOCIAL STUDIES INFERENCE TEST

The relationships between the components of the Social Studies Inference Test were determined for each grade level separately, in order to control for the effects of age. These correlations are presented in Table 6. In interpreting these correlations, it should be remembered that the third grade classes took a shortened version of the Social Studies Inference Test.

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[1] Gamma correlation is a nonparametric statistic which measures the directed order of association; that is, the degree to which the order of X is generally the same as the order of Y. Specifically:

$$\text{gamma} = \frac{\text{Probability of like orders minus probability of unlike orders}}{\text{sum of like and unlike probabilities}}$$

TABLE NO. 6

INTERCORRELATIONS BETWEEN SOCIAL STUDIES INFERENCE TEST FOR PRE AND POST TEST SCORES
(Pearson Product Moment Coefficients)

PRE-TEST

GRADE	N	I-D	I-OG	D-C	D-OG	C-OG
3	129	.26**	.40**	-.09	.13	-.36**
4	58	.44**	.38**	-.19	.19	-.50**
5	116	.53**	.44**	-.31**	.02	-.66**
6	95	.37**	.39**	-.35**	.03	-.47**
4,5,6	269	.52**	.35**	-.31**	.00	-.55**

POST-TEST

GRADE						
3	129	.38**	.34**	-.18*	.04	-.43**
4	58	.31*	.35**	-.05	.04	-.53**
5	116	.53**	.18	-.36**	-.09	-.51**
6	95	.47**	.28**	-.37**	-.08	-.41**
4,5,6	269	.56**	.17*	-.31**	-.13	-.45**

* P $\leq$ .05
** P $\leq$ .01

The relationship between Inference and Caution are not reported because these two scores were not independent.* For both pre- and post-tests, the correlations between Discrimination and Inference were positive, moderate, and of comparable magnitude (median $\underline{r}$ = .50) for each of the grade levels. All were significant beyond the .01 level (except at fourth grade level on post-tests.) Thus, Discrimination accounts for a small portion of the variance in the Inference scores and supports the hypothesis that the ability to discriminate what is presented in a situation is important for selecting "valid" inferences from data.

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* It should be recalled that the same item in the Social Studies Inference Test is scored either as Inference or Caution depending upon the child's response to it.

However, the correlations between these two scores are sufficiently low to warrant their maintenance as separate scores.

The correlations between Inference and Over-generalization were positive and significant (median $\underline{r}$ = .40) for the pre-test scores. However, the correlations between the post-test scores for these tests were considerably lower. Initially, children who over-generalize score higher on Inference. But after training provided by these particular social studies units and the teaching strategies, there is a drop in this relationship. These positive correlations are not consistent with the hypothesis that Over-generalization and Inference scores would be negatively correlated. This expectation is based upon the assumption that children who over-generalize need little empirical data for developing their inferences, and that categories they use are over-inclusive.

One artifact in the nature of the test may explain why the over-generalizer would serve well on Inference. By definition, an over-generalizer is a child who will go as far beyond the data as the test item permits. The nature of the Social Studies Inference Test is such that an Inference item does not permit the child to over-generalize. The furthest he can "go beyond the data" on these items is to select the correct inference. In effect, a child who has a tendency to over-generalize would, by the nature of the test items, receive a high Inference score.

The relationship of the Inference and Over-generalization scores may also be because good interpreters will go beyond what is given and will make valid inferences. However, if they are not yet perfect at estimating the limits, they also tend to over-generalize. This learning of the limits may require more time and emphasis than was available in the period of the study. Also, the over-generalizing child would not be cautious, and therefore would not select the "Can't Tell" alternative. (This was confirmed by negative and significant correlations between Caution and Over-generalization for both pre- and post-test.) The over-generalizer is more likely to accept the extrapolation and therefore would more frequently be correct on "inference."

The over-generalizer may be described as a person who is a good specific point reader (evidenced by the relatively good Discrimination scores) but who is unable to determine the parameters or limits of data. In effect, the over-generalizer "leaps" from specific points to going beyond what the data permit. It is conceivable that the models of thinking developed in the typical social studies program encourage unwarranted generalizing.

The correlations between Discrimination and Caution were negative for each of the grade levels on both pre- and post-tests, the correlations increasing with grade level. The negative correlations would indicate that good data discriminators are less cautious than poor data discriminators. The children's improvement in Discrimination at the higher grade levels seems related to an improvement on Inference which would have the effect of reducing the Discrimination and Caution correlations. Further, as this negative relationship is more pronounced as the grade level increases, this may indicate that age has some effect on the relationship between these components, or that the usual training encourages final or absolute answers, and therefore, the alternative of "Can't Tell" is a mode of thinking which they reject.

The correlations between Caution and Over-generalization are negative and moderately high at all grade levels ($P < .01$). That is, cautious individuals do not permit themselves to go beyond what is given and therefore do not run the risk of making over-generalizations.

In summary, it appears that the tendency to over-generalize is negatively related to being cautious; that there is a moderate relationship between the ability to discriminate among data and to draw inferences. There is a positive relationship between the Inference and Over-generalization scores in the Social Studies Inference Test possibly because both measures are tapping the same tendency to go beyond what is given. The scale, in its present form, tends to identify children in whom the predisposition to over-generalize is predominant.

These findings may have some pertinence for teaching strategy. It is probably best not to focus too early on the generalizations to be acquired. Premature focus on generalization may lead to over-generalizing. It would appear best to develop discriminating data readers in the sense that they can identify the critical points given in a situation. Then focus on the nature of the concepts presented in the data and take considerable time interrelating these concepts, perhaps arriving at a number of generalizations. For example, in comparing literate and non-literate societies, the child's attention should be on determining the relationship between literacy and cultural demands, rather than making value judgments about reading or writing *per se*. Similarly, he would not be concerned with whether hunting or fishing were good or bad in themselves, but with the nature of the society and the occupational opportunities and personal needs of the group; and he would not be concerned with the wrongness or rightness of having to do what one's father does, but with the manner in which learning occurs and how occupational roles are filled. It would seem as though one way to reduce over-generalizing is to develop a frame of reference in which to understand the concepts to be interrelated. In effect, the child's stereotypes would be challenged by counterposing these with other value orientations.

The validity of the generalizations can be tested in a number of ways: 1) do they follow logically from the data given? 2) can we find instances that support the generalization? A refinement of this process would be to discuss what conditions would have to be given or altered in order for the generalization to be valid.

RELATIONSHIP OF TEST WITH OTHER VARIABLES

RELATIONSHIP OF SOCIAL STUDIES INFERENCE TEST TO CHRONOLOGICAL AGE, MENTAL AGE, AND SOCIOECONOMIC STATUS

Table 7 indicates that there is a moderate correlation of chronological age with scores on Inference and Discrimination. There is no correlation between chronological age and scores on either Caution or Over-generalization. Mental age is correlated with Inference at grades four and five, but this correlation is of zero order at the sixth grade level. The Discrimination score is correlated with mental age at the fifth and sixth grade levels. There is no relationship between mental ability and Caution or Over-generalization except for a slight negative correlation between Over-generalization and mental age at the sixth grade level. These correlations suggest that the ability to discriminate among data and to make inferences is related to the age (or grade level, or experience.) Generally, the higher grades score higher on Discri-

TABLE NO. 7

CORRELATIONS BETWEEN THE SOCIAL STUDIES INFERENCE TEST SCORES (PRE-TEST) AND CHRONOLOGICAL AGE, MENTAL AGE, AND GRADE PLACEMENT SCORES ON READING AND SOCIAL STUDIES ACHIEVEMENT TESTS. (Pearson Product Moment Coefficients)

	Grade	N	I	D	C	OG
Chronological Age[1]	4,5,6	269	.28**	.30**	-.10	-.06
Mental Age (N=398)	3	129	.09	.08	.07	-.05
	4	58	.27*	.17	.05	.02
	5	116	.28**	.36**	.01	-.14
	6	95	.08	.34**	-.02	-.25*
Reading (N=398)	3	129	-.20*	.10	.37**	-.21*
	4	58	.27*	.26*	.11	.00
	5	116	.22*	.36**	.12	-.21*
	6	95	.07	.35**	.01	-.37**
Social Studies[2] (N-269)	4	58	.33*	.35**	.13	-.06
	5	116	.22*	.48**	.16	-.29**
	6	95	.15	.32**	.00	-.42**

* $P < .05$
** $P < .01$

[1] Third grades not included in Chronological Age correlations because they were administered a short form of the test.
[2] Social Studies achievement test not administered to third grades.

mination, but this increase is not accompanied by reduction of Caution or Under-generalization.

Evidently, the experience with social studies data that these children had, increased their capacity to make inferences, but did not refine the process sufficiently to improve precision regarding limitations of the data.

Gamma correlation coefficients were computed to determine the relationship between the Social Studies Inference Test and the socio-economic status of the children. These correlations were non-significant at all grade levels indicating that the occupational status of the parents of the children is not related to their children's performance on this test.

RELATIONSHIP OF SOCIAL STUDIES INFERENCE TEST TO ACHIEVEMENT VARIABLES

The correlations between the scales of the Social Studies Inference Tests and the achievement variables of Reading and Social Studies were determined for each grade level separately, in order to control for the effects of age. These correlations are reported in Table 7. The correlations between Discrimination and the achievement variables for the fourth, fifth, and sixth grades are moderately high, significant ($P < .01$), and are approximately the same for both achievement variables.

The correlations of Inference with both Reading Achievement and Social Studies Achievement are low for the fourth and fifth grades and virtually disappear at the sixth grade level. For the fifth and sixth grades, the correlations between Discrimination and achievement are higher than the correlations between Inference and the achievement scores. This is not true at the fourth grade level. This would indicate that the capacity to make inferences is probably not related either to reading or to knowledge of social studies per se. Discrimination as a lower level operation is so related.

The correlations between Caution and the achievement variables are generally low. However, the correlation between Caution and reading at the third grade level is moderate and significant. Generally, it is expected that older children are more analytical and therefore more likely to be cautious. In general, there was no relationship between Caution and the achievement variables. As was suggested above, this may be related to the reluctance to use "Can't Tell" as an answer in responding to the test, or it may be that the development of analytical skills is dependent upon training rather than age.

For the variables of reading and social studies achievement, the correlations with Over-generalization become progressively more negative for the upper grade levels; the correlations being of zero order at the fourth grade level. These correlations suggest that as children become older, the high achievers tend to over-generalize less than low achievers.

RELATIONSHIP OF PRE- TO POST-TEST SCORES FOR SOCIAL STUDIES INFERENCE TEST AND STEP SOCIAL STUDIES ACHIEVEMENT TEST

Means and standard deviations for the pre- and post-tests are presented in Table 8 for the Social Studies Inference Test and for the STEP Social Studies Achievement Test.

The correlations and the t-tests between the pre- and post-tests for each grade level are also reported. An analysis of variance across grade levels 4, 5, and 6 on the pre-test scores yielded significant F ratios for the Inference and Discrimination tests, indicating that there was significantly higher pre-test scores at the upper grade levels on both of these tests.

All grade levels showed a significant increase on Inference ($p < .01$) between the pre- and post-test scores. The difference between the pre- and post-test Discrimination scores was significant only at the fifth and sixth grade levels. All grades showed a significant reduction in Caution scores between the pre- and post-tests, indicating children at each grade level were less cautious in making inferences at the end of the school year than they were at the beginning.

On Over-generalization the only significant difference between the pre- and post-test scores was at the third grade level where an increase was shown. This may be because at this grade level, the children were

TABLE NO. 8

MEANS, STANDARD DEVIATIONS, CORRELATIONS AND t TESTS BETWEEN PRE AND POST TEST SCORES ON THE SOCIAL STUDIES INFERENCE TEST AND THE STEP SOCIAL STUDIES TEST

		3rd Grade[1] (N=129)				4th Grade (N=58)				5th Grade (N=116)				6th Grade (N=95)			
		PRE	POST	r	t	PRE	POST	r	t	PRE	POST	r	t	PRE	POST	r	t
I	M	4.50	6.10	.19	6.30**	14.14	17.33	.28	4.76**	17.18	20.58	.50	6.40**	19.45	22.36	.36	4.62**
	S.D.	2.29	2.25			3.81	4.62			5.63	5.74			5.68	5.09		
D	M	2.90	3.14	.28	n/s	5.93	6.28	.22	n/s	6.88	7.99	.48	4.83**	8.17	9.21	.39	4.52**
	S.D.	1.44	1.51			2.02	2.14			2.39	2.54			2.04	1.95		
C	M	5.20	4.43	.29	2.66**	14.40	11.79	.46	3.88**	12.59	10.91	.49	2.82**	12.75	10.51	.27	3.06**
	S.D.	3.05	2.45			4.46	5.23			6.94	5.67			6.41	5.23		
OG	M	3.69	4.17	.27	2.98**	7.91	8.28	.37	n/s	7.92	7.97	.54	n/s	7.11	6.80	.55	n/s
	S.D.	1.61	1.43			2.65	2.87			3.00	3.47			3.08	2.71		
STEP[2] Social Studies	M					4.37	5.45	.81	8.00**	6.19	7.37	.85	10.98**	8.31	9.10	.67	7.50**
						1.36	1.78			2.14	2.11			1.46	1.15		

* P $<$ .05 One-tailed tests
** P $<$ .01 One-tailed tests

[1] Shortened form of test administered to third grades

[2] Grade Placement scores. STEP Social Studies test not administered to third grades

having their first opportunity in the process of generalizing and, therefore, tended to go further beyond the data than they should.

Children at all grade levels increased significantly on the STEP Social Studies Achievement test. Also, the correlation between the pre- and post-test scores on this test were much higher than for any of the scores on the Social Studies Inference Test. Evidently, the deviation in the curriculum from the traditional content did not affect general achievement. This suggests that training in thought processes may compensate for lack of "coverage."

The children in the fourth and fifth grades increased more than one grade level on the STEP Social Studies Achievement Test. The sixth grade classes did not show a full grade level increase on this test; however, it should be pointed out that their pre-test mean score was at the 8.3 grade level, with many of the children near the top of the norms. This phenomenon produced a restriction in the amount of increase possible at this grade level. In spite of the restriction in growth potential, the 6th grades did increase .89 grade level.

It is interesting to note that, although the children in this study were not exposed to the traditional social studies curriculum or subjected to oriented teaching, their performance on a "traditional" social studies achievement test was slightly beyond the expected rate of progress for the fourth and fifth grade levels, and possibly also at the sixth grade level.

In summary, the children in this study showed significant gains at all grade levels in Inference, and STEP Social Studies Achievement; and, in the fifth and sixth grades, on Discrimination. There was a reduction in Caution scores at all grade levels and no change in Over-generalization scores. The data in this section suggest that children's general achievement in social studies is not adversely affected by the type of teaching strategy used in this study; in fact, it seems to have enhanced the performance. Secondly, the data suggest that the program did in fact affect the child's ability to infer and discriminate more accurately.

Table 8 also presents the correlations between pre- and post-test scores. Interpreting these correlations as stability coefficients (over a nine months' period) it is apparent that considerable shifts occurred on all aspects of the Social Studies Inference Test. The stability coefficients were considerably higher for the STEP Social Studies Achievement scores than for the Social Studies Inference Test scores. For example, the STEP test pre- and post-correlations ranged from .67 to .85, whereas the Inference pre- post-correlations ranged from .19 to .50.

There are two possible explanations for the relatively low stability coefficients of the Social Studies Inference Test: 1) the curriculum is creating large shifts in the children's ability to interpret data; and 2) the Social Studies Inference Test has low reliability. The latter explanation would appear to account for some, but not all, of the shift from pre- to post-test. It should be recalled from Table 4 that there was considerable variance in the odd-even reliability coefficients among the grade levels and among the several scores of the Social Studies Inference Test. For example, for Inference the coefficients for the fourth, fifth, and sixth grades ranged from .64 to .87, and for Discrimination from .63 to .72. If these low stability coefficients are related to the reliability of the tests, it would follow that the sets of scores which have higher reliability should also have high stability coefficients.

However, the data do not support this premise. The stability coefficients of tests at grade levels with high internal consistency (i.e., .85 or above) were no higher than those with relatively low internal consistency (i.e., below .85). For example, the odd-even reliability coefficients for the fifth grades for Inference and Caution were above .85 and for Discrimination and Over-generalization these coefficients were .39 and .55 respectively. (The above data is included in Tables 4 and 8.) It seems more plausible that the variations in stability are a function of the intervening experience rather than the reliability of the tests.

Change scores were secured by computing the difference between the pre- and post-test scores for each child. Analyses of variance across grade levels for change scores were not significant on any of the tests in the Social Studies Inference Test, indicating that there was no differential rate of change between the grades for any of the tests.

RELATIONSHIP BETWEEN CHANGE SCORES ON SOCIAL STUDIES INFERENCE TEST AND STEP SOCIAL STUDIES ACHIEVEMENT TEST

Table 9 presents the correlations between the pre-test and the change scores for the Social Studies Inference Test. The negative correlations between the pre-test Over-generalization and Inference change scores indicates that the initially high over-generalizers made the smallest gains on Inference (except at the fourth grade level). Conversely, this table also indicates that the children with high pre-test Inference test scores were those that showed the least gain in Over-generalization change scores. At the fifth and sixth grade levels there were significant positive correlations between

TABLE 9

CORRELATIONS BETWEEN PRE-TEST AND CHANGE SCORES FOR SOCIAL STUDIES INFERENCE TEST (Pearson Product Moment Coefficients)

				CHANGE SCORES		
	Grade	N	I[1]	D	C[2]	OG
PRE-TEST SCORES I	3	129		-.11		-.17*
	4	58		.26*		-.33*
	5	116		-.18		-.23*
	6	95		-.23		-.36**
	4-5-6	269		-.16*		-.30**
PRE-TEST SCORES D	3	129	-.04		.06	-.05
	4	58	.11		.15	-.18
	5	116	-.03		.08	-.21*
	6	95	-.21*		.27**	-.15
	4-5-6	269	-.11		.15*	-.20**
PRE-TEST SCORES C	3	129		.09		.18
	4	58		.15		.06
	5	116		.18		.19
	6	95		.27**		.34**
	4-5-6	269		.18**		.22**
PRE-TEST SCORES OG	3	129	-.22*	-.05	.15	
	4	58	.08	.20	.11	
	5	116	-.32**	-.07	.40**	
	6	95	-.32**	-.22*	.33**	
	4-5-6	269	-.27**	-.15*	.33**	

* $P < .05$

** $P < .01$

[1] Correlations between pre-test and change scores for the same scale omitted because of regression effect.

[2] Correlations between Inference and Caution scales omitted because of the interdependence of the scales.

pre-test Over-generalization scores and change scores on Caution which suggests that initially high over-generalizers at these grade levels were those that became the most cautious during the school year.

Table 10 presents the intercorrelations of the change scores for the Social Studies Inference Test and the STEP Social Studies Achievement Test. The significant positive correlations in this table suggest that children who had the largest increase in Inference scores were also those who had the largest increase in Discrimination and Over-generalization scores. Also the significant negative correlations between Caution and Over-generalization change scores reveal that the children who had the greatest reduction in caution were those who became the over-generalizers, and conversely, the children who showed the greatest reduction in over-generalization were those which became the most cautious. The negative correlations between the Caution scores and the Discrimination scores suggests that the children who became better discriminators were at the same time becoming less cautious and vice versa.

The generally non-significant correlations between the STEP Social Studies Achievement Test and the scores on the Social Studies Inference Test indicate that there is no relationship between the amount of improvement in achievement and improvement in the ability to make inferences.

In summary, the children who became better discriminators were those who also became better inference makers. Also, the children who made the greatest gains in making inferences went even further beyond the data and showed increase in over-generalization. In the process of these changes these children also became less cautious.

TABLE NO. 10

INTERCORRELATIONS OF SOCIAL STUDIES INFERENCE CHANGE SCORES AND STEP SOCIAL STUDIES CHANGE SCORES (Pearson Product Moment Coefficients)

				CHANGE SCORES			
		GRADE	N	D	C	OG	STEP SS[1]
CHANGE SCORES	I[2]	3	129	.20		.27**	
		4	58	.31**		.38**	.11
		5	116	.26**		.32**	.12
		6	95	.44**		.53**	-.05
	D	3	129		-.19*	.02	
		4	58		-.16	.22	.16
		5	116		-.27**	.14	-.07
		6	95		-.45**	.29**	.05
	C	3	129			-.27**	
		4	58			-.29*	.01
		5	116			-.40**	-.08
		6	95			-.51**	.08
	OG	3	129				
		4	58				-.13
		5	116				-.05
		6	95				-.20*

* $P < .05$
** $P < .01$

[1] Step Social Studies Test Not Administered to Third Grades

[2] Correlation between Inference and Caution change scores omitted because of the interdependence of these tests

RELATIONSHIP OF CHANGE SCORES ON SOCIAL STUDIES INFERENCE TEST TO CHRONOLOGICAL AGE, MENTAL AGE AND ACHIEVEMENT VARIABLES

The correlations of chronological age, mental age, reading achievement and STEP Social Studies Achievement pre-test scores with the Social Studies Inference Test change scores are presented in Table 11.

The amount of change on any of the scores is not related to any of these variables, with the exception that mental age is related to Discrimination change scores, and Reading to the change scores on Inference and Discrimination at the third grade level. This would indicate that the reading and mental ability of the children at this grade level may be a factor in understanding the content of the Social Studies Inference Test.

There is also a slight negative correlation of reading achievement and STEP Social Studies Achievement Tests with change scores in Over-generalization. This may indicate a tendency for initially high achievers at this grade level to reduce their tendency to over-generalize.

TABLE NO. 11

CORRELATIONS OF CHRONOLOGICAL AGE, MENTAL AGE, READING ACHIEVEMENT AND STEP SOCIAL STUDIES ACHIEVEMENT PRE-TEST WITH SOCIAL STUDIES INFERENCE CHANGE SCORES (Pearson Product Moment Coefficients)

			CHANGE SCORES			
	GRADE	N	I	D	C	OG
Chronological Age	4,5,6	269	.00	.06	.01	-.06
Mental Age	3	129	.06	.25**	-.05	-.04
	4	58	.05	.09	.15	-.07
	5	116	.02	.08	-.08	-.21*
	6	95	-.04	-.06	.08	.01
Reading	3	129	.23**	.24**	-.14	.04
	4	58	.00	.07	.10	-.14
	5	116	.03	.15	-.10	-.23*
	6	95	.04	.00	-.04	.10
STEP[1] Social Studies	4	58	.08	.04	.09	-.05
	5	116	.11	.11	-.17	-.18*
	6	96	-.02	.03	.00	.18

* $P < .05$
** $P < .01$

[1] STEP Social Studies Test not administered to third grade

CHAPTER VII

THE CODING OF CLASSROOM INTERACTION

Classroom discussions provided another source of data on the processes of thought, as well as on the teaching strategies. Four classroom discussions, each of about an hour's length, were recorded in each of the twenty classrooms participating in the study which ranged from the second through the sixth grade. These discussions were addressed to three cognitive tasks: 1) grouping and classification, 2) making inferences from data, and 3) predicting consequences of described conditions (if-then) by applying known principles and facts.

Because the curriculum outline projected a detailed sequence of learning experiences, it was possible to tape each discussion at a point in a sequence which involved a specified cognitive task of concern to the study. The discussion involving grouping and classification was taped during the very first class session. The next two discussions, which involved interpretation of data, were taped at the midyear. One of these discussions concerned interpretation of a film and another represented a session in which committees reported information from their research, compared and contrasted their data, and attempted to generalize from their findings. The film ("African Girl") was shown to all classes in order to get one set of comparable responses to a common content stimulus from all grades. The final taping, at the end of the school year, recorded discussions which required students to apply previously learned knowledge in predicting consequences from described hypothetical conditions.

The first tapes were taken within a span of one week. The discussion of the film "African Girl" was taped over a long period of time in order to permit each class to have some experience in their learning sequence which prepared them for the type of analysis of culture that the interpretation of this film required. The tapings of the committee discussions were distributed over a longer span of time also, as these discussions came at different points in the sequence of learning experiences for different grade levels.

This necessity of placing the tapings of the three cognitive tasks at different points of the year's sequence had the disadvantage in that the material on each task reflected different degrees of experience with the cognitive skills. For example, the discussion involving grouping and classification was recorded during the very first class session, when neither the teachers nor the students had much skill either in the type of discussion or the type of thought process involved. In contrast, the discussion involving application of principles came at the very end and therefore presumably reflected the learning of the entire year.

Under these circumstances it was impossible to secure comparative growth data on skills entailed in the same cognitive task. However, owing to the short duration of the study, there was no other alternative. But, since the study was an exploratory one, the tapings served the chief purpose of developing and testing a serviceable method of classifying and coding thought processes rather than securing definitive data from these classifications.

THE FOCUSING FOR THE COGNITIVE TASK

Although the nature of the cognitive tasks was common to all grade levels, the content varied from grade to grade. The initial focusing questions which set the cognitive tasks were formulated by the teachers of each grade level as a group, but the specific follow-up questions to induce the development of the sequential steps in the task were developed by individual teachers in the course of the discussion.

The common questions for each grade level are given below.

Discussion 1. Cognitive task: grouping and classification

This task coincided with what is called an Opener in the curriculum guide and represented the very first session of the class.

2nd grades:	When you go to the store what do you buy?
3rd grades:	What are the materials that houses are made out of?
4th grades:	What do you think California might have been like long ago?
5th grades:	What do you remember about the early California explorers?
6th grades:	What differences would you expect to find if you lived in Latin America?

Discussion 2. Cognitive task: interpretation and inference

Film: African Girl

Since in this discussion both the task and the stimulus content were the same for all grades a common question sequence was developed by all teachers for all grade levels. These questions were not the best possible ones for the purpose because it was necessary to avoid questions which the verbal commentary in the film had already answered. This question sequence is as follows:

1. What happens in this picture? (Let the class mention items on any level to make sure that there is sufficient basis in concrete descriptive information for the second question.)

2. Which of these things stood out especially for you (or seemed important or startling) and why? (If these first questions do not open up the class, use these kinds of questions as follow up:

2.1 What did you notice about home life?

2.2 What did you see about the market place?

2.3 What did you notice about food?)

3. How does it happen that children help with building a house in the picture, when they do not here?

4. Why do girls carry things on their heads?

5. How do you think Malobi feels about her way of life?

Discussion 3. Cognitive task: interpretation and inference

These discussions were tape recorded at a point at which either through individual research or committee work some data had been accumulated which required interpretation, integration, and generalization.

2nd grades: What kinds of services are available in the local community?

3rd grades: What changes are occurring in Africa?

4th grades: What changes took place from the Mission period to the Rancho period in California?

5th grades: What changes have been made in America by people from other countries coming here?

6th grades: What changes have occurred in Brazil, Argentina, Bolivia, and Guatemala?

Discussion 4. Cognitive task: Applying known information and principles to explain new phenomena or to predict consequences of described conditions

In addition to differences of content on this grade level the focus for this task was diverse also, partly because no model was available for training, and partly because the task calls for divergent thinking.

2nd grades, Classes 21, 22: What would happen if all of a sudden the farmers in (local town) did not have irrigation water?

3rd grades, Classes 31, 32, 33: Suppose all the deserts were irrigated with water. How would this change the nomad's way of life?

Class 34: Let's suppose that the Sahara desert region might get all the water it could possibly use. What kind of changes would this make for the people who live there?

Class 35: Suppose there was plenty of water on the desert. They were able to get all the water they needed from rain or wells or some way. What would happen?

4th grades, Classes 41, 42: Imagine that oil was discovered in the desert. What are some of the problems they would have?

Class 43: In a desert area in California a man discovers oil. What would happen in that area of California?

5th grades, Classes 51, 52, 53, 54, 55: Suppose that Americans suddenly discovered a large, beautiful island out in the Pacific Ocean right close to California inhabited by uncivilized people who were farmers. Gold was discovered on this island. What would happen?

6th grades, Classes 61, 62, 63: What would happen if the beef industry in Argentina failed?

Class 64: What would happen in Argentina if a blight of some kind moved in and killed off the range on which the cattle rely for their food?

THE FORMULATION OF THE CODING SCHEME

Several theoretical considerations influenced the shaping of the coding scheme. Any behavior as complex as thought can be analyzed by using innumerable breakdowns. In order to determine which particular breakdown is most useful for a given purpose, it is necessary to have some frame of reference in terms of which to develop the categories, to relate them to each other and to assess their meaning.

This study was especially concerned with examining the development of thought under the twin impact of curriculum and teaching strategies designed for an explicit emphasis on cognitive learning. It was our hypothesis that under these conditions students would master formal operations of thought at an earlier age than is suggested by studies conducted with untrained children.

This focus set several demands on the method of recording and of analyzing classroom interaction.

First, it was evident that categories for analyzing thinking should reflect the complexities of thought in classrooms in order to secure information about the ways of improving the teaching of cognitive skills. Second, since the study was concerned with the progress in cognitive skills, it seemed important to devise a method of coding which would reveal the changes in the quality and the level of cognitive functioning. This suggested a coding system which differentiated or scaled the levels of thought along such lines as concreteness and abstractness, simplicity and complexity, and isolation and relatedness.

The study was also based on the concept of teaching and learning as a dynamic transaction between teachers and students. This concept required a method of coding which permitted an assessment of the impact on teaching acts and the nature of thinking expressed by the students. It was therefore necessary to develop a coding system which would describe the teacher acts in the light of the pedagogical functions they served and, at the same time, assess these functions in terms of their product; i.e., the levels of thinking they generated. It seemed necessary, for example, to differentiate between teaching acts that control and those that open up the thinking. For example, teacher statements and questions may function as open invitations to discovering and performing certain processes of thought while leaving open the particular content. Others are controlling in the sense that they fix both the content and the form of thought. A question, "Has anyone thought of something more general on this topic?" serves to shift thought from a specific to a general level. It is an open question because it permits students to determine the meaning of "general" and does not prescribe the particular expected content. In contrast, a question such as, "Let's talk about early days in California" predetermines the specific content, while leaving open the level of thought, such as whether the talk should concern specifics or general features of Early California. Determining the content such questions prevents activity on the part of students who have nothing to say on Early California. Furthermore, "Let's talk about" does not focus the "talk"; i.e., gives no hint as to the type "talk" that is expected.

The concept of teaching as a set of complex strategies imposed still another set of requirements on the coding system. It seemed necessary to be concerned not only with the frequencies of the types of teacher acts, but with the combinations, sequences, and patterns of these acts; i.e., with teaching strategies. For example, the concept of thinking employed in the study included the idea of a hierarchical sequence in the development of cognitive skills, in which the skills on each preceding level are a prerequisite for adequate performance on the next level. Consequently, it seemed necessary to describe teacher behavior so as to make it possible to determine whether it provided for appropriate transitions from one level of thought to another, represented appropriate pacing and timing in doing so, and provided an appropriate focus for the level of operation sought. The concept of assimilation and accommodation as a cycle of movement in thinking called for such strategies as rotating questions which focus on extension of thought on the same level (assimilation) with questions that call for lifting of thought to a higher level (accommodation) such as shifting from description to explanation.

Finally, in order to assess growth, provisions were needed either in the coding, in the analysis, or both, for assessing the levels of thought both within and across the three cognitive tasks. It seemed evident that each major cognitive task, such as classification, interpretation, and application, involved certain unique processes and sequences. In other words, each of the three cognitive tasks involved something akin to its own logic of operations and sequences important enough to preserve in the coding system, at least in the exploratory phase of the study. For this reason it was decided to treat each cognitive task as a separate unit in coding and to deal with the problem of change across cognitive tasks by designing an appropriate method of analyzing the data. (See Chapter VIII.)

The above considerations suggested the need for a multidimensional analysis of classroom interaction, and therefore a multiple scheme of coding classroom dialogue consisting of the following:

1. The coding of teacher behavior in terms of the pedagogical functions this behavior serves in the development of cognitive processes of the students.
2. Categorizing students' responses in a manner which describes a) the nature of their cognitive operations and b) yields a

direct measure of the quality or level of these operations, and in terms of their complexity and abstractness.

3. A way of relating teaching strategies to the cognitive behavior they produce in students.

It seemed obvious that this three-dimensional analysis would not permit too refined a differentiation within the categories of coding, without making the task of coding overly difficult, and possibly also rendering the product useless because the forest would not be visible for the trees.

Several categories of analysis were tried and discarded in the process of experimentation and revision. Among these were the attempts to differentiate between different forms, such as questions and statements, and to identify the errors and fallacies of thought, such as appeal to authority, overcautiousness, irrelevance. A similar decision was made regarding coding to assess the validity of the content of thought. The final coding scheme retained only the distinctions of the crudely irrelevant or incorrect statements.

THE UNIT OF CODING One problem in analyzing classroom transactions for the purpose of describing thought processes is to determine the units of analysis which are at once capable of being coded accurately and which express sensible units of thought.

In spite of its obvious advantage as far as reliability of coding is concerned, the time unit was discarded in favor of a "thought unit" in order to preserve the contextual meaning of the statements. "Thought unit" was defined as a remark or series of remarks which expresses a more or less complete idea, serves a specified function, and can be classified by a level of thought. It is, therefore, possible for one word or an entire paragraph to be designated as a "thought unit." For example, the word "cement," when it occurs in the process of enumerating materials for building houses, is considered a thought unit. So is a paragraph, such as, "The people in the other country do not have electric saws and things that the men in this country use to build houses. The children help chop the wood and can do a lot of things to help build the houses. But the children over here cannot do very many things because of the danger." This definition gave larger units of an uneven length to code, both factors which made the problem of establishing reliability more difficult.

THE SYSTEM OF CODING In order to describe simultaneously the teaching acts and the levels of thinking of students, the verbal transactions were "scored" by three different sets of codings. The first is that of designation. It describes the source of the thought unit: whether it emanates from the teacher or from the student and whether the person is giving or seeking information. The code symbols for designation are:

(CG) - child gives
(CS) - child seeks
(TG) - teacher gives
(TS) - teacher seeks

The coding of function describes the pedagogical functions of a thought unit in the context of discussion. When applied to remarks or questions by teachers, these codings may be used to describe teaching strategies which affect the subsequent thought of children.

Two large groups of function codings are distinguished: 1) questions or statements made by the teacher or the students which are psychological or managerial in their function and are unrelated either to the logic of the content or to the level of thought. Statements of this type express the following:

(A) - agreement
(AP) - approval
(D) - disagreement
(DP) - disapproval
(M) - management
(R) - reiteration

2) Teacher or student statements which function to give direction to discussion, but which, at the same time, can be coded according to the level of thought and the logic of content. Such codings include:

(F) - focusing
(FR) - refocusing
(FC) - change of focus
(FD) - deviating from focus
(C) - controlling thought
(X) - extending thought on the same level
(L) - lifting thought to a higher level

The third coding of levels of thought describes both the student's and the teacher's verbal behavior by specifying the logical quality and the level of thought expressed. A separate coding scheme was developed for each of the three cognitive tasks, and categories were established to represent hierarchical levels of thought, such as giving information, (10, 11, 12) grouping (30, 31, 32), and categorizing (40, 41, 42) in the cognitive task of grouping and labeling. These categories refer to the specific thought processes which need to be mastered in a sequential order, because the mastery on the preceding level is a prerequisite to performance on the next. Thus, this coding scheme in a sense represents the developmental sequence of steps for each cognitive task. In addition, within each category, distinctions were made between the irrelevant, the disconnected, and the contextual or related information. Thus, where possible, the distinctions within a category were ordered from lower to higher levels of thought.

The coding scheme used for designating the levels of thought for each of the cognitive tasks is as follows:

Cognitive task: Grouping and labeling*

(giving or seeking)

10	specific or general information outside of focus
11	specific or general information within focus
12	specific or general information with qualifications*
30	grouping information without basis
31	grouping information with implicit basis
32	grouping information with explicit basis
40	categorizing information without basis
41	categorizing information with implicit relationships between items
42	categorizing information with explicit relationships between items

Cognitive task: Interpreting and making inferences

(giving or seeking)

10	specific or general information outside of focus
11	specific or general information within focus
12	specific or general information with qualifications and relationships
50	specific reason or explanation that does not relate to the information
51	specific reason or explanation that relates or organizes the information
52	specific reason or explanation that states how it relates or organizes the information
60	irrelevant or incorrect inference which is derived from information
61	relevant inference which is derived from information
62	relevant inference which is derived from information and expresses a cause and effect relationship, explanation, consequence, or contrast

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* Categories in the 20 series were originally reserved for "general information" but were later combined with the 10 series.

ERRATA

p. 8	line 20	change the word "they" to read: "Kagel, Moss, and Sigel (1960)"
p. 41	line 23	delete the word "had" at the end of the line.
p. 53	line 15	insert the word "by" at the end of the line.
p. 61	line 10	insert the word "and" after "accommodation".
p. 61	line 11	change the word "was" to "were".
p. 81	line 12	correct spelling of "occurance" to "occurrence".
p. 91	line 16	change the word "serve" to "score".
p. 112	line 22	change the word "on" to "of".
p. 112	line 23	change the word "and" to "on".
p. 113	line 13	insert the word "by" before "determining" and insert comma after "content".
p. 133	line 19	change "undated" to "1962".
p. 147	line 19	change the word "bears" to "hears".

The following references were omitted:

Contra Costa County Schools. *Social Studies, Grades 1 - 6*. Pleasant Hill, Calif. 1959.

Conant, J.B. *The Education of American Teachers*. New York: McGraw, Hill. 1963.

Kagan, J., H.A. Moss, and I.E. Sigel. "Conceptual Style and the Use of Affect Labels". *Merrill-Palmer Quarterly of Behavior and Development*, 6, July, 1960, pp. 261-278.

6-1-64M

70	relationship between information which implies an irrelevant or incorrect principle or generalization
71	relationship between information which implies a principle or generalization
72	principle or generalization which is derived from information

Cognitive task: Predicting consequences

(giving or seeking)

90	correcting the cause or condition

Establishing parameters of information

100	irrelevant information
101	relevant information for establishing the parameter (if-then) for a particular hypothesis or prediction
102	relevant information for the parameter or any particular prediction with appropriate explanation

Establishing parameters of conditions

110	irrelevant or untenable condition for the logical parameter or for the particular prediction or hypothesis
111	relevant condition without connecting it with relevant information
112	relevant condition and information and plus a logical connection between them

Prediction: (Level one, (100), immediate consequences)
(Level two, (200), remote consequences)

120-220	incorrect or out of focus prediction
121-221	prediction with no elaboration
122-222	prediction accompanied by explanation, qualification, differentiation, comparison, or contrast
123-223	prediction accompanied by a stated or implied principle

In determining the level at which to code a particular thought unit, it was necessary to consider the context in which the thought unit occurs. A particular thought unit may be assigned to a different level, depending upon the context in which it appears. For example, the statement: "a hammer, because you can drive large nails with it" may be coded as "specific information with qualifying statement" if it is offered in response to the task of naming tools used in building a house because it merely gives additional information about the hammer and does not constitute a reason for naming "hammer." However, if the focus is on identification of tools most useful to primitive people, the same response would be coded as "relevant inference derived from information," because the phrase is an explicit inference regarding the role of "hammer" in a primitive society.

The complete coding scheme is presented in Appendix E.

THE RELATIONSHIP OF FUNCTION CODINGS TO THE LEVEL OF THOUGHT

In describing the effect of teaching strategy on thought levels, four groups of function codings are especially important:

(F) - focusing
(X) - extending the thought on the same level
(L) - lifting thought to a higher level
(C) - controlling thought

Focusing establishes both the topic and the particular cognitive operation to be performed. It sets the cognitive task. For example, the question by the teacher, "If the desert had all the water it needed, what would happen?" establishes the central focus for discussion and calls for prediction of consequences.

The coding system also specifies the shifts in subject matter (change of focus), the degree to which the teacher finds it necessary to bring the discussion back to the original topic (refocus), and the number of times that the discussion wanders from the subject (deviation from focus).

A statement of the teacher or a child is coded as extension of thought (X) when it gives or seeks additional information or provides elaboration and clarification on an already established level. The following example illustrates a series of extensions on the level of providing specific information:

1) C Malobi took money home with her. CG 11

2) T What did Malobi do with the money? TS 11

3) C She saved it. CG 11X

4) C She put it underground. CG 11X

5) C She put sticks and tin over it. CG 11X

6) C Before she did that, she put it in a little pot. CG 11X

A thought unit is functioning to lift the level of thought (L) whenever the teacher or child seeks or gives information that shifts thought to a higher level than had previously been established. In the following example the teacher attempts to lift the level of thought from giving information to explanation.

1) C They carried things in baskets on their heads. CG 11

2) T Explain why. TS 61L

3) C I suppose they can carry more things that way. CG 61L

A question may function to extend the thought in one context and to lift it in another, as illustrated in the following example:

1) C They were working fast on the house. CG 11

2) T Why? TS 51L

3) C They wanted to get the house done before the rain came. CG 51L

4) T Why? TS 51X

5) C Because unless it is finished the rain will destroy it. CG 52X

The inquiry on line 2 is coded as teacher seeking to lift the level of thought from the established one of giving specific information to the level of inference. The child's response provides the reason on the level sought by the teacher. The same inquiry on line 4 and the child's response on line 5 function to extend the thought because the level at which the question is asked has already been established.

Controlling of thought occurs when the teacher performs a cognitive operation that students should be induced to do. This is the case when the teacher gives a category for classification, an inference in interpretation, or a prediction in the task of applying principles.

In the following example, the teacher is supplying the categories, a task which the children should be doing.

1) T Let's think of some other classifications and then we can go through these and put them under classifications and it might help us to make out what are people and what are things. What would be another big classification? TS 41

2) C Customs CG 41

3) T That could go under people, too. TG 41C

4) C Talents. CG 41

5) T Talents. Wouldn't that go under people? I think it would. TG 41C

As elements of teaching strategy, the frequencies and combinations of these functions may represent either effective or ineffective teaching strategies. For example, frequent shifts in focus may be needed at some points in the discussion to introduce sufficient information to form a basis for comparison and generalization. Other tasks may require that the discussion remain on one level long enough to provide ample assimilation before proceeding to another, higher level thought. Frequent refocusing may indicate a faulty handling of the sequence in thought processes, which results in the necessity for constantly having to bring the children back to the focus.

THE RELIABILITY OF CODING

Instead of facing the problem of training an external jury of judges in the method of complex coding, a conference or a team method for coding was adopted. This consisted of the independent coding of a sample of tapescripts by two staff members who were responsible for developing the coding scheme. The differences were ironed out in conference until a consensus was reached or a correction was made in the coding system.

After the categories and the criteria were stabilized, two staff members coded independently one tapescript in order to obtain a measure of rater reliability. In using this coding scheme two problems were encountered in obtaining reliable codings: 1) agreement as to the division of the tapescript into thought units; and 2) agreement in assigning codings to the thought units.

The tapescript that was used as a check for reliability contained a total of 336 thought units. The two judges designated the units of thought with a high degree of reliability, disagreeing in less than 7% of the cases. One judge divided the tapescript into 348 thought units and the other designated 326 units.

In assigning codings to the thought units, the two judges assigned the same ratings in 50% of the thought units. However, when the differentiations were reduced (i.e., when 41 and 42 were combined) agreement between the judges increased to 90%. In the final analysis of the discussion data these codings were further combined to yield only three levels which would undoubtedly have even higher reliability.

After the reliability of the codings was established, one of the staff members coded the remainder of the tapescripts, conferring with the other member whenever in doubt.

THE PATTERNS OF CLASSROOM INTERACTION

This multiple coding scheme makes it possible to depict the flow of the classroom discussion by charting the sequences of transactions between the teacher and the children, the changes in the level of thought during the discussion, and the effect of these strategies upon the level and the direction of thought.

Figure 1 presents the first 40 thought units in a third grade tapescript. In this flow chart, the thought units are represented by equal intervals on the horizontal axis and their level on the vertical axis. Thus, the systematic progression of the thought units and the relative levels of thought can be presented diagrammatically. The thought units of the teacher are indicated by "T" along the horizontal axis. The horizontal arrows, such as appear for thought units 7 and 13, represent the teacher's request for an extension of the thought expressed just prior to these units. The vertical arrows shown for thought units 9, 15, 28, and 36 depict the teacher's attempts to lift the thought to a higher level. Thought unit 10 (L), indicates that the child complied with the teacher's request for a lift in level and produced a thought unit at the 41 level. The other letters represent other function codings such as reiteration, approval, agreement, etc.

By examining the chart, the flow of thought can be reconstructed even though the specific content of the discussion is not given. For example, the sequence of thought presented in thought units 12 through 17 may be read as: child gives specific information (unit 12); teacher seeks an extension of that information (unit 13); child provides the requested extension (unit 14); teacher seeks to lift the level of thought from the

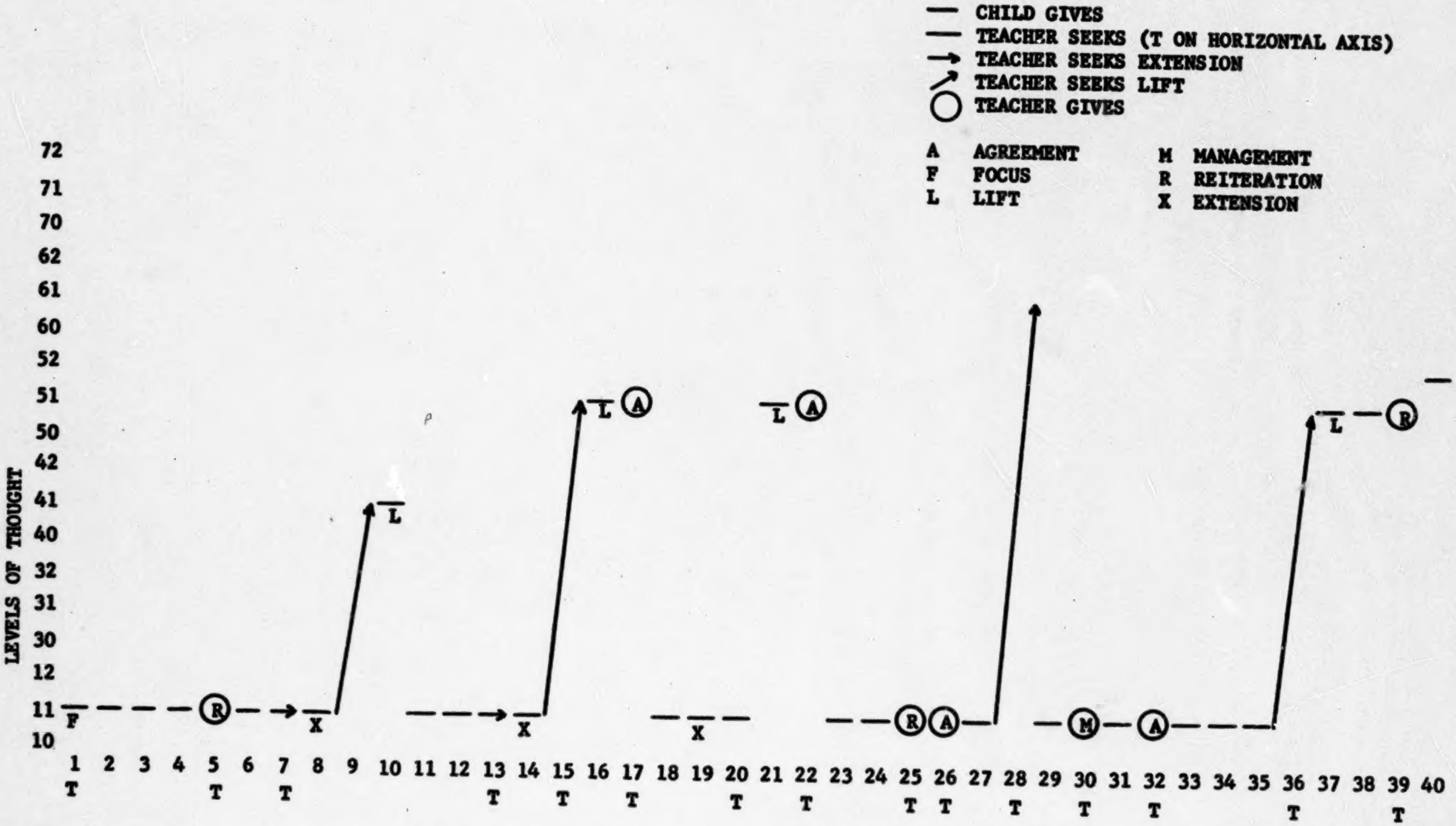

FIGURE 1

FLOWCHART OF CLASSROOM INTERACTION

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"information" level to the "reason" level (unit 15); child provides a reason as requested by the teacher (unit 16); teacher gives approval to the child (unit 17).

Other patterns can be depicted by this method. For instance, the child gave an unsolicited lift at unit 21 which was approved by the teacher at unit 22. The discussion then dropped back to the information level at unit 23 where it stayed until the teacher attempted to lift the thought at unit 28. This was unsuccessful as indicated by the child's response at unit 29 which is again at the information level. The teacher sought a lift at unit 36 which was successful and the level of thought seems to now be sustained at the "reason" level as indicated by the units 37 through 42. Any sequence of codings can be reconstructed from the flow chart in similar manner.

Not shown in this illustrative flow chart is the identification of individual children. However, since each child was identified by a number, this identification permits one to describe the characteristic modes and levels of thought of individual children, such as a tendency to operate only on the level of concrete information or on the level of inference and generalization, the tendency to remain focused or to stray from the focus, to give relevant or irrelevant information, etc. It also permits the accounting of the frequencies of the various thought patterns which prevail in the group, and the discrepancies between what the teacher seeks and how the children respond.

Figure 2 presents four simplified class discussion patterns which depict various strategies teachers may employ. Pattern A illustrates a type of discussion in which the teacher attempts to raise the level of thought very early in the discussion. This results in the children returning to a lower level, and their inability to sustain discussion at the higher levels of thought. Pattern B depicts a type of discussion which demonstrates an effective pacing of shifting the thought onto higher levels. The level of seeking information is sustained for a considerable time during the first portion of discussion. Grouping is requested only after a large amount of information has been accumulated. The result is that, in a fairly brief period, children make the transitions from grouping to labeling, to providing reasons for labeling, and, finally, to inferences.

In pattern C the teacher repeatedly attempts to steer discussion to the inference level without permitting the development of a body of needed information and the children repeatedly return to the information level. Pattern D illustrates a constant change of the focus, with the result that thought alternates between several levels, is not sustained at the higher level, and gradually stabilizes on the most primitive one.

Figure 3 shows still another constellation: a fanning out of the divergent hypotheses in response to the questions of what would happen to the way of life in the desert if enough water was available. Each concentric circle represents a leap in prediction from the original condition. The vertical area represents the divergent lines of prediction. This figure reveals the cognitive map of the classroom interaction and the different ways in which the bits of information provided by one person lead to further predictions by other students.

As far as teaching strategies are concerned, this type of discussion demands the most of the teacher. Since in actual discussion these leaps of predictions and their verification are not orderly, the class can easily lose the focus unless the teacher has a cognitive map in her mind. An

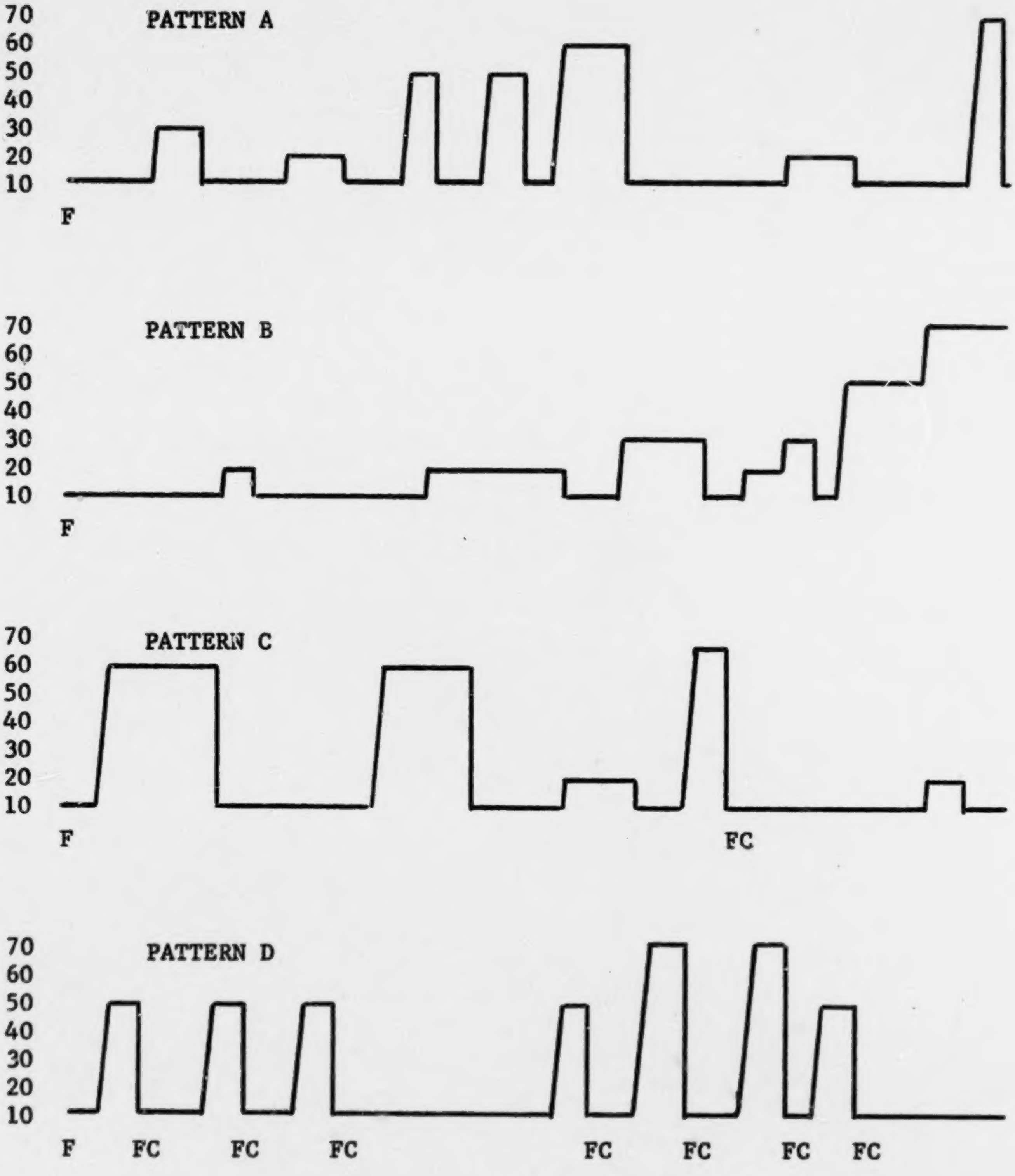

FIGURE 2

CLASS DISCUSSION PATTERNS

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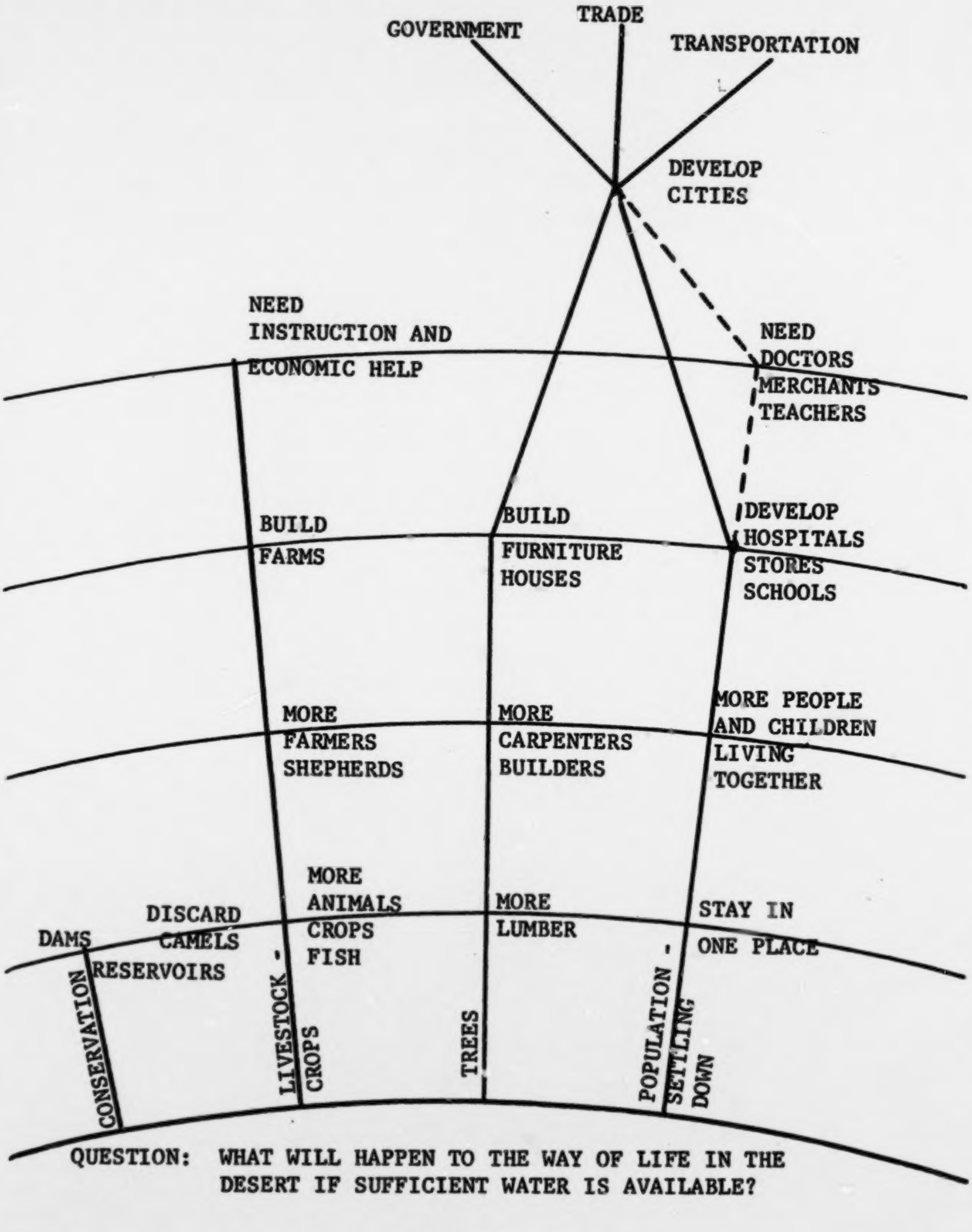
GOVERNMENT
TRADE
TRANSPORTATION
DEVELOP CITIES
NEED INSTRUCTION AND ECONOMIC HELP
NEED DOCTORS MERCHANTS TEACHERS
BUILD FARMS
BUILD FURNITURE HOUSES
DEVELOP HOSPITALS STORES SCHOOLS
MORE FARMERS SHEPHERDS
MORE CARPENTERS BUILDERS
MORE PEOPLE AND CHILDREN LIVING TOGETHER
DAMS
DISCARD CAMELS
RESERVOIRS
MORE ANIMALS CROPS FISH
MORE LUMBER
STAY IN ONE PLACE
CONSERVATION
LIVESTOCK - CROPS
TREES
POPULATION - SETTLING DOWN
QUESTION: WHAT WILL HAPPEN TO THE WAY OF LIFE IN THE DESERT IF SUFFICIENT WATER IS AVAILABLE?

FIGURE 3

COGNITIVE MAP OF CONTENT IN THIRD GRADE DISCUSSION

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adequate cognitive map also aids the teacher in recognizing promising leads and in helping children maintain a focus.

THE ADVANTAGES OF THE MULTI-DIMENSIONAL ANALYSIS

This multi-dimensional analysis of classroom transactions has several advantages. First, by combining the description of the teacher acts in terms of their explicit functions with the assessment of the logical quality of student responses, it is possible to evaluate the impact of teacher behavior in terms of its productivity. The addition of the dimension of the logical quality of thought carries the analysis of classroom transactions a step beyond that which is available to date.

A further advantage lies in the fact that, in addition to describing the impact of teaching exclusively in terms of the frequencies of specific acts, this scheme permits the study of the cumulative impact of certain patterns or combinations of acts, including their pacing. It is at this point that a transition is made from the study of teaching acts to the study of teaching strategies. Flanders has taken a step in this direction by describing the points of shift in the nature of teaching acts. (Flanders, undated).

Finally, this scheme permits the examination of the effect of teaching strategies in terms of a measurable change in a specified outcome, levels of thinking in this case, and thus frees the study of teaching from the necessity of inferring the effect from the assumed consequences of the frequencies of certain types of teacher behavior.

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CHAPTER VIII

THE ANALYSIS OF CLASSROOM INTERACTION

As was pointed out in the preceding chapter, the multidimensional coding designed to detect patterns in both the teaching acts and student responses presented certain difficulties for analysis. First, it was necessary to process the raw data by a special program for a high speed computer (Stone, 1963). Even though this program was explicitly designed for this study, it still fell short of accounting for all the possible combinations and patterns for the simple reason that, ahead of analyzing the data, it was impossible to predict what these patterns and combinations might be.

This chapter, then, presents an analysis of such combinations of and comparisons of the data as was possible to derive from the computer analysis of the raw data. These include the general pattern of participation, some characteristics of the classroom interaction between students and teachers, comparisons of the pedagogical functions of the teacher behavior with the products of these functions, an analysis of the student performance by thought levels, and the relationship of this performance to the IQ and the scores on the Social Studies Inference Test.

THE ANALYSIS OF PARTICIPATION

It must be remembered, first, that the teaching strategy was addressed largely to enhancing independent thought on the part of the children, and that the teacher's role was confined largely to eliciting student participation. Therefore, there was scarcely any expository activity on the part of the teacher.

However, even under these conditions, there are factors which limit students' participation. One is the degree of openness which the focusing questions permit. As was pointed out in Chapter VII, the teachers of each grade level as a group formulated the initial focusing questions or statements for each discussion in the training sessions. Even then, there was some variation in the manner of presenting these focusing questions to the class and considerable variation from teacher to teacher in the follow-up questions. The second factor is the level of operation that the focus demands. On high levels of thought the ability factor might prevent some children from expressing themselves. In addition, previous habits of thought function also by hindering the discovery and use of new modes of conceptualization.

The percentages of children who participated in the classroom discussions are presented in Table 12.*

As can be seen from this table, there is a wide range in the degree of participation, ranging from 33% in Class 53 to 100% in Classes 43 and 64 on Discussion 1 and in Classes 35 and 61 on Discussion 3. Over all discussions, Classes 43, 61, 63, and 64 had the highest percentage of participation, which exceeded 90% in each. Class 62 had the lowest participation over all discussions, with only 55% of the children participating. Discussion 4 generally had the smallest amount of participation (70%) across all grades. A casual check against participation counts in other studies indicates that this percentage of child participation is higher than seems to be usual.

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* Because each discussion produced a differing number of thought units and because the number of children present during the discussions differed from class to class, the only meaningful way to analyze the codings was by comparing percentages rather than frequencies. Accordingly, many of the tables that follow contain percentage figures which were derived separately for each class and grade level in order to render them comparable.

TABLE 12

PERCENTAGES OF PARTICIPATING CHILDREN
BY CLASSES AND GRADE LEVELS

	Discussions				
Class	1	2	3	4	Total
21	70	71	82	50	69
22	79	71	62	61	68
23	83	80	80	82	81
2nd Grade	77	74	74	64	72
31	95	73	95	84	87
32	96	61	57	62	69
33	68	75	65	59	67
34	58	74	83	78	73
35	95	95	100	65	88
3rd Grade	79	75	79	69	76
41	87	81	80		83
42	82	74	91	64	78
43	100	95	89	89	93
4th Grade	89	83	87	76	84
51	35	73	69	52	58
52	73	85	63	81	78
53	33	66	95	62	64
54	42	94	63	67	66
55	65	95	92	78	82
5th Grade	50	82	78	69	70
61	95	90	100	90	94
62	76	50	50	44	55
63	96	95	96	91	94
64	100	88	88	86	91
6th Grade	92	81	83	77	83
TOTAL	76	79	80	70	76

The grade level percentages indicate that participation generally increases with grade level, except in one fifth and one sixth grade class where the number of participants was quite low (50%).

INTERACTION BETWEEN TEACHING STRATEGIES AND THOUGHT LEVELS

One object of this study was to discover the relationship between the teaching strategies and the children's level of thinking.

It seemed important to compare the relationship between the frequency of teacher's giving or seeking and children's responses.

Table 13 presents the percentages of thought units that were given or sought by the teacher or child by grade levels and for each discussion. The distribution of these percentages varies very little from discussion to discussion and even from grade to grade. Students tend to produce more thought units than do teachers, the over-all percentage of child units being 58% as against 42% for teachers. The children produced a slightly smaller percentage of thought units in Discussion 1 than they did in the later discussions.

The percentage of the thought units given by children increased slightly from Discussion 1 to Discussion 4. On discussion 1 teachers gave more thought units than on any of the other discussions. This may be due to the fact that this discussion occurred in the first week of school, at which time neither the teachers nor the children had much skill in handling discussions and both were nervous about being taped. In addition, the teachers were as yet unaccustomed to the new strategy and possibly took the problem of managing the discussion with the least interference a bit too seriously.

The percentage of child seeking is low at all grade levels and for all discussions. Since the strategy involved programming the development of thought into "digestible steps", fewer questions may have been necessary on the part of the children.

EXTENSIONS OF AND LIFTS OF THOUGHT LEVELS

Among all teaching functions, extending and lifting the level of thought were most important in guiding the dynamics of thought. "Extending" means carrying on discussion on the same level of thought, and

TABLE 13

PERCENTAGES OF THOUGHT UNITS THAT ARE CLASSIFIED AS CHILD GIVES, TEACHER SEEKS, TEACHER GIVES, AND CHILD SEEKS

		PERCENTAGES				PERCENTAGES	
1st DISCUSSION	TOTAL UNITS	CG	TS	TG	CS	CHILD	TEACHER
2nd Grades	580	56	25	19	0	56	44
3rd Grades	1338	54	24	22	0	54	46
4th Grades	480	55	21	23	1	56	44
5th Grades	388	65	18	16	1	66	34
6th Grades	1400	47	21	30	2	49	51
TOTAL	4186	53	22	24	1	54	46
2nd DISCUSSION							
2nd Grades	687	55	27	17	1	56	44
3rd Grades	1322	52	28	17	3	55	45
4th Grades	539	67	23	9	1	68	32
5th Grades	987	66	26	7	2	68	33
6th Grades	964	57	25	18	0	57	42
TOTAL	4499	58	26	14	2	60	40
3rd DISCUSSION							
2nd Grades	805	55	29	16	1	56	44
3rd Grades	981	59	28	14	0	59	42
4th Grades	636	60	28	12	0	60	40
5th Grades	1125	64	27	9	0	64	36
6th Grades	1798	50	30	19	1	51	49
TOTAL	5345	56	28	15	1	57	43
4th DISCUSSION							
2nd Grades	864	52	25	22	0	52	47
3rd Grades	1185	57	28	15	0	61	43
4th Grades	459	61	24	15	0	61	39
5th Grades	1405	60	29	9	2	62	38
6th Grades	878	67	18	12	2	69	30
TOTAL	4791	59	26	14	1	60	40
TOTALS	18,821	57	26	16	1	58	42

"lifting" means seeking transition from one level to a higher one. Since the teachers were trained in the skill to obtain extensions and lifts in thought level, it would be expected that they would be successful in eliciting these responses and that the children would respond with adequate frequency to each solicitation. Table 14 presents the percentages of these two functions and the frequency of their success.

The teachers sought extensions of thought for 10% of the total thought units. This was consistent for all grade levels and for all discussions.

Also, 10% of the thought units were those in which the child gave extensions. There was very little variation in these percentages across grade levels or across discussions. However, these percentages should not be interpreted to mean that extension was given every time the teacher sought it. To determine the extent to which the teachers were successful in their solicitations of extensions, the percentage of the teacher seeking extension of thought that was followed by a child giving it was computed and is presented in column 3 of Table 14.

From the second discussion on, the seeking of extensions by teachers was successful in over 50% of the instances. Successful solicitation of extension also tends to increase from Discussion 1 to Discussion 3. The second grade teachers had the least success in soliciting extension of thought in all four discussions.

Columns 4 and 5 indicate the percentages of the solicited and volunteered extensions given by the children. The tendency to volunteer extensions was greater in the earlier discussions than in the later ones. This might be explained in part by the differences in the nature of the cognitive tasks involved. The first discussion called for recollection

TABLE 14

PERCENTAGES OF THOUGHT UNITS SOUGHT BY THE TEACHER (TS) AND GIVEN BY THE CHILD (CG) THAT ARE EXTENSIONS OF THOUGHT (X) AND LIFTS IN LEVEL OF THOUGHT (L)

	EXTENSIONS (PERCENTAGES)						LIFTS (PERCENTAGES)				
	TOTAL THOUGHT UNITS	(1) TSX	(2) CGX	(3) TSX CGX	(4) Solicited	(5) Volunteered	(6) TSL	(7) CGL	(8) TSL CGL	(9) Solicited	(10) Volunteered
Discussion #1											
2nd Grade	580	9	4	24	52	48	2	1	50	88	13
3rd	1338	10	6	38	61	39	1	1	44	57	43
4th	480	10	11	69	65	35	1	2	86	60	40
5th	388	11	13	73	61	39	2	2	100	78	22
6th	1400	8	6	47	61	39	1	1	92	85	15
TOTAL	4186	9	7	47	62	38	1	1	71	74	26
Discussion #2											
2nd Grade	687	10	8	43	54	46	2	2	75	75	25
3rd	1322	11	10	75	86	14	3	4	84	76	24
4th	539	9	10	84	48	52	3	5	76	50	50
5th	987	7	9	81	59	41	4	6	60	35	65
6th	964	10	8	56	68	32	2	6	86	30	70
TOTAL	4499	9	9	67	67	33	3	5	76	47	53
Discussion #3											
2nd Grade	805	10	11	73	64	36	3	3	78	75	25
3rd	981	10	11	83	75	25	3	4	80	54	46
4th	636	10	16	90	55	45	2	2	60	46	54
5th	1125	12	16	80	63	37	1	2	53	35	65
6th	1798	9	11	81	65	35	4	6	83	51	49
TOTAL	5345	10	13	81	65	35	3	4	76	53	47
Discussion #4											
2nd Grade	864	10	9	70	83	17					
3rd	1185	12	13	82	79	21					
4th	459	11	10	76	77	23					
5th	1405	12	11	71	78	22					
6th	878	8	9	75	69	31					
TOTAL	4791	11	10	75	77	23					
ALL DISCUSSIONS	18821	10	10	69	68	32	2	2	76	53	47

from general experience of rather simple points, which made it easier for the children to indulge in association and to volunteer extensions.

In Discussions 2 and 3, which dealt with interpretation, the main reference point was to the data presented in one form or another. The children, therefore, were constrained by data and less free to generate associations from the remarks of others. This would result in fewer spontaneous extensions. In Discussion 4, which generated divergent dimensions of prediction, a number of topics were under discussion at the same time so that the extending of a particular thought did not occur at the moment when it was solicited. Extensions that did not occur immediately after solicitation were not scored as such and therefore were not coded. As was expected, the percentage of spontaneous extensions decreased on the upper grade levels.

The same type of analysis was made for the lifts in the level of thought. Columns 6 through 10 of Table 14 give the percentage of thought units in which the teacher sought and the child gave lifts of thought. Column 6 shows that, over all discussions, 2% of thought units represented lifts sought by the teacher. This is considerably less than the 10% of all thought units devoted to seeking extensions of thought. Lifts of thought were sought in only 1% of the total thought units in Discussion 1 and 3% in Discussions 2 and 3. These percentages may not be low considering the fact that the "lift" coding was used only at the point at which the transition from one level to another occurred. The initial lift may have been followed by numerous thought units on the same level which were coded as extensions. This lingering on one level for a reasonable time was a conscious strategy and was dictated by the idea that an adequate pacing of assimilation and accommodation required a fairly prolonged activity on a given level in order to make sure that a large portion of the children assimilated the cognitive operation involved before attempting transition to another level.

Somewhat higher percentages of lifts were obtained in Discussions 2 and 3 (5% and 4%) than in Discussion 1 (1%). Also, in the later discussions, the sixth grade children gave the largest percentages of lifts.

As shown in column 8, across all discussions the teachers were successful in their attempts to lift the level of thought 76% of the time. Generally, also, the sixth grade teachers had more success in soliciting lifts than did teachers in the lower grades. However, there were variations among grade levels and discussions. The percentages of successful attempts at lifting thought ranged from 44% (Discussion 1, 3rd grade) to 100% (Discussion 1, 5th grade). The median of successful lifts was above 70% in all three discussions. This would indicate that for the most part teachers used good judgment in pacing the transitions from one level to another.

The coding scheme for Discussion 4 did not include the "lift" coding. Instead, chains of thought and links in the chain were coded. These are not reported in Table 14 as they occurred in less than 1% of the total thought units.

The analysis of the "lifts" in Discussion 1 indicates that solicited lifts (74%) exceeded the volunteered (columns 9 and 10). In Discussions 2 and 3 the "lifts" were split approximately 50-50 between the solicited and the volunteered, the children in the upper grades (fifth and sixth) volunteering considerably more "lifts" than the children in the lower grades. This is consistent with the general theory of the development of cognitive patterns discussed in Chapter III, namely, that increased experience brings about an increased capacity to operate on the more formal thought level, even without training. Focused training ought to increase the autonomy in thought and with it the spontaneous movement toward the higher levels of thought. In addition, one would expect a larger number of thought units to follow on the same level after the initial "lift" has occurred. As mentioned earlier, these subsequent thought units were not recorded as "lifts".

Other functions used to describe the interaction during the discussions dealt with focusing, agreement and disagreement, and management. The percentages of these functions are presented in Table 15.

FOCUSING

Three types of focusing were identified: focusing per se, (F), refocusing (FR), and change of focus (FC). Only the initial setting of the task was coded as focusing, hence the frequencies of this function were too small to be reported separately.

Focusing and refocusing included setting the dimensions of the larger task, bringing students back to the point, and preventing diversion. This was generally accomplished by questions from the teachers. In effect, these two codings served the same purpose. Change of focus usually occurred when the new dimension of the topic was being sought.

As shown in Table 15, at all grade levels the teachers sought to refocus the discussion by asking questions designed for this purpose more frequently than by making statements.

The frequency of refocusing is somewhat lower for the upper grade levels than for the lower ones. If one assumes that a clearcut, developmental learning sequence is observed in the strategy of questions and

TABLE 15

PERCENTAGES OF TEACHER FUNCTION *
CODINGS OTHER THAN EXTENSIONS AND
LIFTS FOR ALL DISCUSSIONS COMBINED

GRADE	TOTAL UNITS		PERCENTAGE TEACHER FUNCTIONS	PERCENTAGES							
				A	AP	D	M	R	C	FR	FC **
2nd	2936	Seeks	9	26	0	8	2	9	0	17	37
		Gives	15	11	3	2	16	49	9	6	4
3rd	4826	Seeks	8	18	0	13	12	4	1	13	38
		Gives	14	14	2	2	16	49	7	5	5
4th	2114	Seeks	10	20	0	9	3	4	0	14	50
		Gives	12	7	14	2	21	40	6	5	5
5th	3905	Seeks	10	18	0	10	1	4	0	12	55
		Gives	6	5	4	1	15	45	10	6	13
6th	5040	Seeks	8	25	0	13	7	5	2	8	39
		Gives	16	12	12	1	19	44	8	2	2
TOTAL	18,821	Seeks	9	21	0	11	6	5	1	12	44
		Gives	13	11	7	2	18	46	8	4	4

* The functions of disapproval (DP) and deviation from focus (FD) are not presented as these occurred in less than 1% of the total thought units.

** Initial focus (F) codings are combined with change of focus (FC) codings.

that each step is properly paced, there would be less need for refocusing as instruction proceeds. Furthermore, younger children, because of their shorter attention span, are likely to need more refocusing. The higher the level of the organizing concepts which the children can manipulate, the larger is the field of the content to which they can address themselves without becoming confused. Generally, the mental organization of the younger children is composed of smaller units of conceptual schemes. Therefore, it is easier for them to get off the track. This means that two factors determine the amount of refocusing that occurs: 1) the developmental nature of the cognitive organization, and 2) the quality of the teaching strategy. The current data do not permit a clear distinction between the relative effect of these two factors.

Almost one half (44%) of all functions sought by the teachers represented seeking a change of focus. The percentages of refocusing increase steadily from the second grades (37%) to the fifth grades (55%). The sixth grade teachers only sought change of focus in 39% of the teacher function codings. In this respect, the sixth grades more nearly resembled the second grades. It is not clear whether this resemblance is caused by the similarity in the background of the children, in teaching styles, or the nature of the cognitive task and the content of the discussions.

Changes in focus were also accomplished more frequently by the teachers seeking the change (44%) than by their giving it (4%). Evidently, these teachers relied on questions rather than statements in their attempts to change the focus of the discussions.

AGREEMENT AND DISAGREEMENT

It was assumed that by coding "agreement" and "disagreement" it would be possible to get some idea about the emotional tone employed by the teachers. Actually, the agreement and disagreement seem to have affected more the content of thought than the emotional climate.

At all grade levels the teachers sought more agreement and disagreement than they gave. This, no doubt, is related to the teaching strategy which stressed the development of autonomy on the part of the children and the reduction of their dependency on teacher's judgment. The high percentage of seeking agreement in comparison to giving it is somewhat misleading. It can be accounted for by the fact that these teachers were in a habit of seeking confirmation from the children for the statements they made. This confirmation was usually in the form which the children could answer by a simple "yes" or "no." The teachers sought agreement almost twice as much (21%) than they sought disagreement (11%). This suggests that the teachers generally sought confirmation of accurate instead of denial of inaccurate information.

APPROVAL AND DISAPPROVAL

Approval and disapproval serve about the same function as agreement and disagreement. Neither approval nor disapproval had a serious impact in affecting the course of the discussions. Disapproval was rarely used. Approval was used relatively infrequently also (7%) and was perceived by both teachers and students as a casual habit rather than a serious commendation.

REITERATION

Reiteration was used abundantly by teachers. It constituted 46% of all the teacher functions and was used in the same proportion on all grade levels. This frequency is also a result of a habit of making sure that the entire class bears the remarks of individual children, and seemed to have little perceptible impact on the course of the discussions.

CONTROL

By definition, control includes all the instances in which the teachers give what they should have sought from the students, such as a new dimension of a topic or a new level of thought. The teachers in the study used very little (8%) of this type of control. This is a very small proportion when compared with the findings from such studies as Marie Hughes' (1959), who found control of thought functioning in as much as 70% of teacher acts, according to her definition of control.

MANAGEMENT

The category of management included all statements pertaining to the mechanical arrangements, establishing the routines for the discussion such as calling on students or establishing an order of participation, and directions for organizing the proceedings.

Statements addressed to management accounted for 18% of the teacher functions. The teachers sought decisions on management from children less frequently (6%). Management by teachers is fairly evenly distributed across all grade levels, but seeking management from the class is concentrated largely in the sixth grades (7%).

THE ROLE OF THE TWO TYPES OF PEDAGOGICAL FUNCTIONS

Generally, the literature suggests that there are marked differences between teachers who are good managers, but perhaps less effective in guiding learning directly, and those who are the opposite. Since this research on thinking was based on the assumption that, if both the curriculum and teaching strategies made a difference in what students learned, it was necessary to secure direct information on teacher activity which was "content-free" and that which was "content-related." Presumably, while the former affects learning indirectly, the latter has a direct bearing on it. For this reason it was necessary to distinguish the thought units which were related to thought and its content from those which were directed largely to creating appropriate conditions. In order to examine this, the teacher thought unit codings were divided into two groups:

Group A This group represents those thought units given or sought by the teachers that are "content-related" in the sense that they serve to establish the level and to direct the operations of thought during the discussion. This group included all thought units in which the teacher gave or sought 1) a specific thought level, 2) an extension (X) or lift in level of thought (L), 3) focusing (F), refocusing (FR), or changing of focus (FC), and controlling of thought (C).

Group B This group represents the thought units given or sought by the teacher that are "content free" in the sense that they are not anchored to a specific level of thought but serve a psychological or a managerial function. The functions included in this group are Agreement (A), Approval (AP), Disagreement (D), Disapproval (DP), Management (M), and Reiteration (R).

Table 16 shows the percentages of teacher thought units (given or sought) that were content free and content related.

As shown in the second column of this table, 42% of all the thought units were either given or sought by the teacher. In only two classes (23 and 64) did the teachers exceed the children in the percentage of thought units.

Generally, these teachers emphasized content and thought about twice as frequently as they did the psychological and managerial functions. Of all the teacher units, 66% were content-related (Group A) and 34% were content-free (Group B). There was little variation in these percentages or in their ratios from class to class, the one notable exception being in Class 64 where the content-free units slightly exceeded the content-related units. In part, this can be accounted for by the fact that when the sequences in the development of thought are

TABLE 16

PERCENTAGES OF TEACHER THOUGHT UNITS THAT ARE CONTENT RELATED (GROUP A) AND CONTENT FREE (GROUP B) FOR ALL DISCUSSIONS COMBINED

		PERCENTAGES								
					Teacher Seeks			Teacher Gives		
Class	Total Thought Units	Total Teacher Units	Total Group A	Total Group B	A	B	Total	A	B	Total
2nd Gr.										
21	1067	41	72	28	60	5	65	12	23	35
22	828	44	68	32	49	11	60	19	21	40
23	1041	51	58	43	43	10	53	15	33	48
TOTAL	2936	45	65	35	50	9	59	15	26	41
3rd Gr.										
31	1180	37	70	30	57	8	65	13	22	35
32	947	49	64	36	53	8	61	11	28	39
33	897	47	61	39	46	11	57	15	28	43
34	718	35	84	26	66	5	71	8	21	29
35	1084	50	57	43	46	11	57	11	32	43
TOTAL	4826	44	64	36	52	9	61	12	27	39
4th Gr.										
41	611	36	67	33	54	11	65	13	22	35
42	890	36	72	28	64	7	71	8	21	29
43	613	45	55	45	40	10	50	15	35	50
TOTAL	2114	39	65	35	54	9	63	11	26	37
5th Gr.										
51	1091	43	76	24	64	12	76	12	12	24
52	562	22	74	26	57	6	63	17	20	37
53	573	36	80	20	72	3	75	8	17	25
54	677	40	80	20	65	9	74	15	11	26
55	1002	32	81	19	67	9	76	14	10	24
TOTAL	3905	36	78	22	65	9	74	13	13	26
6th Gr.										
61	1869	45	69	31	53	8	61	16	23	39
62	660	28	70	29	55	8	63	15	21	36
63	854	42	63	37	45	7	52	18	30	48
64	1657	53	49	52	37	10	47	12	42	54
TOTAL	5040	45	61	40	46	9	55	15	31	46
ALL GRADES	18,821	42	66	34	53	9	62	13	25	38

matched to the capacity of students to master the requisite skills there is less need for either management or psychological support. The latter is supplied by the achievement of mastery.

Of all the teacher units, 62% were sought and 38% were given. As the grade level increases, there is also a slight increment in percentage of thought units sought by the teachers over those given them except in the sixth grades which most nearly resemble the third grades. This suggests that the strategy of asking questions, which the training emphasized, had taken root. The fact that there is an increment in the "seeking" strategy toward the higher grades, suggests that when the strategy is applied to more mature students the managerial functions can be reduced, presumably because the students can take a greater responsibility for directing their own thought.

There was a difference in the type of thought units sought and given by the teacher. The teachers sought more of the Group A (53%) than they did of Group B (9%), whereas, they gave more of Group B (25%) than they did Group A (13%). Evidently, the majority of the teacher activity was devoted to asking questions which were related to thought and content. In contrast, only 13% of the thought units given by the teacher were content related. This means that, at least in these particular discussions, information giving by the teacher was at a minimum. This characteristic of the teaching style is also in contrast to findings in other studies which usually show that information giving by teachers far outweighs information seeking.

COMPARISON OF THOUGHT LEVELS ACROSS THE THREE COGNITIVE TASKS

As was mentioned before, the cognitive tasks were of differing levels of difficulty. To measure change throughout the year it was necessary to compare the performance across the three cognitive tasks. This required an hierarchical scheme of analysis which differentiated the levels of difficulty across the three cognitive tasks and reflected at the same time the difference in the difficulty levels of the various tasks. In order to accomplish this the thought level codings of the units given by the children were consolidated into three hierarchical levels of cognitive functioning which are presented in Table 17. The distribution of these units into the three levels varies according to the task. The particular allocations are somewhat arbitrary as no information was available on the actual amount of the difference in the difficulty from level to level. This is especially true in the case of Discussion 4 where it was impossible to assess the difficulty involved in the "leap" of the predictions in comparison to the parameters of information and of the logic of conditions. For example, all predictions were allocated to a lower level than both the informational and logical parameters of the conditions for these predictions. There is no firm evidence whether, in fact, the establishment of conditions represents a more difficult intellectual task than prediction.

Table 18 presents the comparisons of observed frequencies with expected frequencies at the three cognitive levels of the thought units given by the children.

The observed frequencies decreased markedly from Level I to Level III on all discussions, with the exception of Discussion 1 where the frequency of labeling (Level III) exceeds that of grouping (Level II). Evidently, more of discussion is devoted to lower than to higher levels of thought and labeling and categorizing is a less difficult operation than making inferences from data and hypothesizing. As the distribution of observed frequencies in Table 18 shows, in Discussion 1 virtually no responses were given

TABLE 17

GROUPING OF THOUGHT LEVEL CODINGS OF THE THREE COGNITIVE TASKS INTO THREE LEVELS OF COGNITIVE FUNCTIONING

COGNITIVE TASK	LEVEL I	LEVEL II	LEVEL III
Grouping and Labeling (Discussion 1)	11-22 Enumerating specific and general information	31-32 Grouping information	41+ Categorizing and labeling information
Interpreting information and making inferences (Discussions 2 and 3)	11-42 Enumerating, grouping and categorizing	51-61 Giving reasons or making inferences	62+ Making inferences and stating cause and effect relationships Stating principles
Predicting consequences and explaining new phenomena. (Discussion 4)	121 & 221 Predicting and explaining without rationale	101-102 201-202 111 & 211 122 & 222 Giving information that establishes parameters. Giving conditions. Predicting or explaining with reasons, etc.	112 & 212 123 & 223 Stating conditions and establishing logical connections Predicting accompanied by stated or implied principles

TABLE 18

THE OBSERVED (0) AND EXPECTED (E) FREQUENCIES OF THOUGHT UNITS GIVEN BY THE CHILDREN AS DETERMINED BY CHI SQUARE CALCULATIONS

		Discussion #1				Discussion #2				Discussion #3				Discussion #4			
		I	II	III	TOTAL	I	II	III	TOTAL	I	II	III	TOTAL	I	II	III	TOTAL
2nd Grades	0 =	155	43	51	249	181	67	21	269	234	68	15	317	185	84	4	273
	E =	173	14	62		146	99	24		166	112	38		164	90	19	
3rd Grades	0 =	490	55	41	586	328	207	26	561	290	154	44	488	357	187	20	564
	E =	407	33	146		305	207	49		256	173	59		338	186	39	
4th Grades	0 =	158	1	51	210	182	96	24	302	219	104	3	326	143	45	14	202
	E =	146	12	52		164	111	26		171	116	39		121	67	14	
5th Grades	0 =	178	0	64	242	251	234	46	531	242	251	100	593	348	225	67	640
	E =	168	13	60		289	196	46		311	210	72		384	212	44	
6th Grades	0 =	286	2	248	536	213	178	69	460	305	295	135	735	272	178	46	496
	E =	372	30	134		250	169	40		386	261	89		298	164	34	
TOTALS	0 =	1267	101	455	1823	1155	782	186	2123	1290	872	297	2459	1305	719	151	2175
	E =	1066	526	231		1241	612	269		1438	709	312		1272	627	276	

at Level II in the 4th, 5th, or 6th grades. These grade levels skipped grouping and proceeded from enumeration to categorization. In part, this could be accounted for by the fact that some teachers had not mastered the strategy of sequential development of the discussion, as this was the very first session of the class. Furthermore, the content of the discussions in the 4th, 5th, and 6th grades was conducive to the enumeration of specifics and then naming rather obvious general categories for classifying them. Neither the teachers nor the children had the mental schemes with which to group these categories into a still more abstract and encompassing ones.

In order to determine the relationship between the level of difficulty and the nature of the cognitive task, a chi square test was performed using the frequencies of responses at the three cognitive levels for the four discussions for all grades combined. The observed frequencies along with the expected frequencies (based upon chi square calculations) for this analysis are presented as the "totals" in Table 18. This over-all chi square was 801.63 (df=6, $P < .01$). This significant finding indicates that the association between the level of difficulty and the cognitive task was non-random.

In Discussion 1 the observed frequencies exceeded the expected frequencies (based upon chi square calculations) at Levels I and III. In Discussions 2 and 3 the observed frequencies were larger than expected at Level II. In Discussion 4, Levels I and II had larger frequencies than would be expected by chi square computations. This indicates that it is easier to perform the operations of grouping and classification and to give reasons than it is to make inferences in the light of consciously stated cause and effect relationships and to setting factual and logical connections between conditions and predicted consequences. In other words, as the cognitive skills involved in the task approach formal thinking the frequency of their use decreases.

To determine what relationship existed between the level of thought and the grade level, chi square tests were conducted on the frequencies of child responses by thought level (I, II, and III) and by grade level for each of the four discussions. The data for these calculations are also presented in Table 18.

An analysis of the discussions yielded the following chi square values:

Discussion 1 chi square = 342.03 df = 8, $P < .01$
Discussion 2 chi square = 75.09 df = 8, $P < .01$
Discussion 3 chi square = 198.57 df = 8, $P < .01$
Discussion 4 chi square = 61.35 df = 8, $P < .01$

For Discussion 1, the observed frequencies which exceeded the expected according to chi square computations are given below:

2nd grades observed frequency exceeded expected in Level II
3rd grades " " " " " Level I & II
4th grades " " " " " Level I
5th grades " " " " " Level I & III
6th grades " " " " " Level III

The pattern of responses that exceeded the expected, based upon the chi square computations, were identical for discussions 2 and 3 and are given below:

2nd grades observed frequency exceeded the expected in Level I
3rd grades " " " " " " Level I
4th grades " " " " " " Level I
5th grades " " " " " " Level II
(Level III, Discussions 3 and 4 only)
6th grades observed frequency exceeded the expected in Levels II and III

These analyses indicate that the lower level responses were supplied predominantly at the lower grade levels (2nd, 3rd, and 4th), whereas the higher levels of thought were produced predominantly by the children in the upper grades (5th and 6th). Thus, age and experience factors evidently operate over and above the training factor.

RELATIONSHIP BETWEEN WHAT TEACHERS SEEK AND THE CHILDREN'S RESPONSES

The relationship between what was sought by the teacher and what was given by the children describes the effect of the teaching strategy on the thought patterns of the children. Both in the formulation of the teaching strategy and in training, the strategic function of questions was emphasized. Consequently the analysis of the relationship between what the teachers asked and the level of responses children gave was crucial in determining the impact of this aspect of the teaching strategy.

Figure 4 shows graphically the percentage of thought units that were given by the children and sought by the teacher on the same level for each of the grade levels.* This graph shows a striking similarity of percentage distributions between the levels of thought units which the teacher sought and the children gave. It also shows the gradual reduction of the percentage of thought units at the lower level (Level I) and a steady increase in the higher levels (Levels II and III) as the grade level increases. The percentage of irrelevant thought units (Level 0) is gradually reduced as the grade level increases.

CLASSIFICATION OF PARTICIPATION OF INDIVIDUALS

Since the verbal behavior of children in the classroom was one of the criterion measures used in this study, it was important to determine what relationship obtained between the discussion data and other data on thinking, as well as with ability. Because the amount of verbal behavior in different classes and on different discussion varied, it was necessary to devise some method for establishing a baseline against which an individual's behavior could be assessed. In order to do this it was necessary to develop a system for classifying children's responses that included both the degree of participation and the level of the thought expressed.

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* See Appendices C and D for the data from which this figure is drawn.

To obtain data on participation, the children in each of the twenty classes were classified as either high or low participators. This classification was made by determining the median percent of participation for each class and placing all children who participated less than this in the "Low Participation" category and those who participated more than this in the "High Participation" category.

In addition to classifying participation, it was necessary to determine the characteristic level of functioning for each child in each discussion. To determine this, the percentage of each child's thought unit codings for each of the three cognitive levels was ascertained. These percentages were then compared with the percentage of responses falling into three levels for the entire class. The highest level at which a child's percentages exceed the class percentages was designated as his typical level. That is, if a child's percentage at Level III was above the class percentage at Level III, he was categorized as performer on Level III. If he was not above the class percentage of Level III, but was above it at Level II, he was categorized as performer on Level II. If he was above the class percentage at Level I and below the class percentage at Levels II and III, he was categorized as performer on Level I.

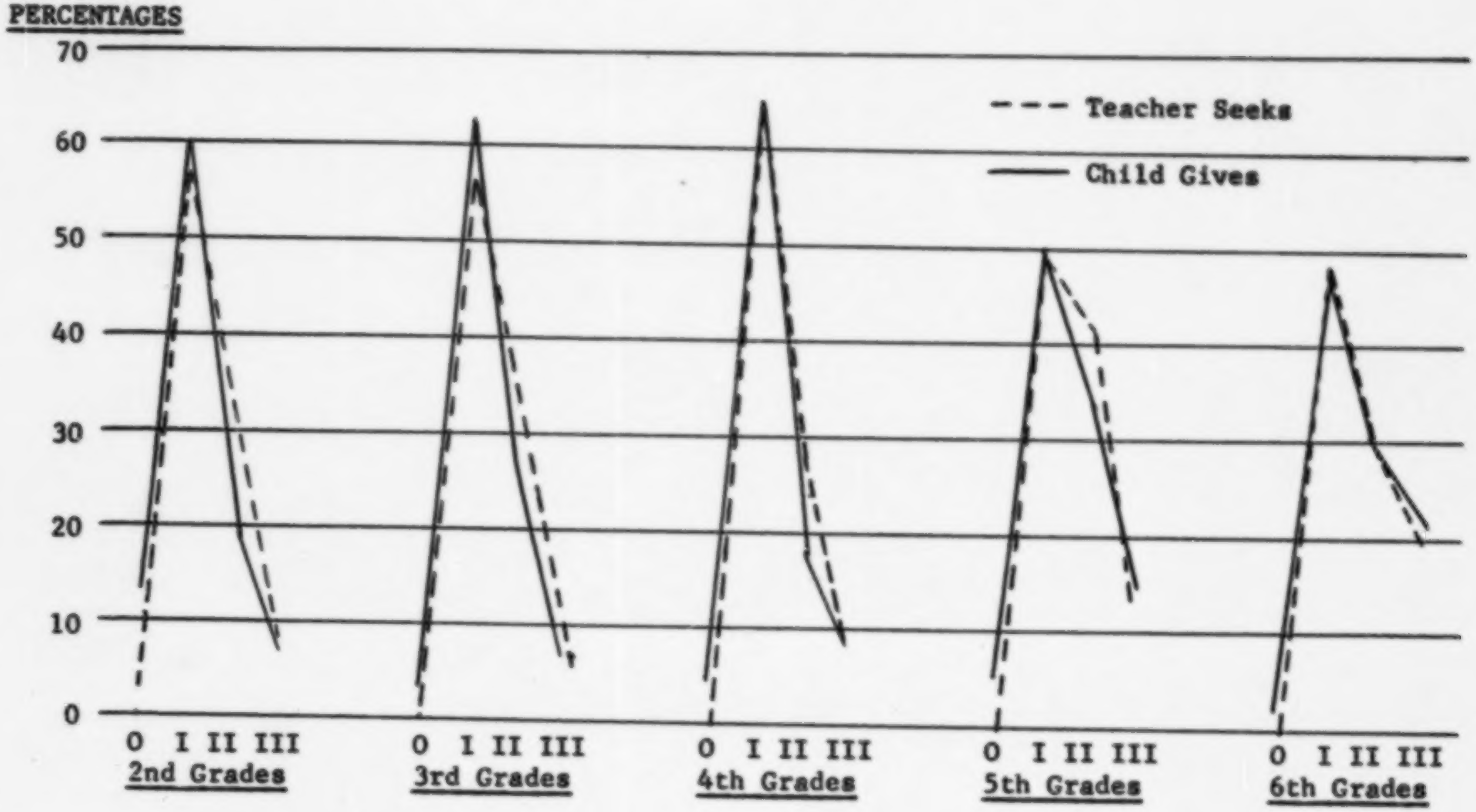

FIGURE 4

COMPARISON OF PERCENTAGES OF THOUGHT UNITS GIVEN BY CHILDREN AT VARIOUS THOUGHT LEVELS WITH PERCENTAGES OF THOUGHT UNITS THAT TEACHERS SEEK AT THE SAME LEVELS

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For example, if the percentages of a particular class discussion yielded 55% responses at Level I, 35% at Level II, and 10% at Level III, then each child's percentages at the three levels were compared against these class percentages. If a child in this class had 57% responses at Level I, 38% at Level II, and 5% at Level III, he would be considered as having a characteristic thought level of II, because this level is, for him, the highest level at which he exceeded the class percentages. The characteristic thought level for each child in the class was determined in a like manner.

Each child was classified in two ways: his degree of participation in the classroom discussion and the thought level that was typical of him. This system permits each child to be classified into one of the following six categories for each discussion:

A	High thought level	High participation
B	High thought level	Low participation
C	Middle thought level	High participation
D	Middle thought level	Low participation
E	Low thought level	High participation
F	Low thought level	Low participation

For chi square analyses, these six categories can be arranged into a 2 x 3 matrix and code letters assigned to each of the six cells as shown below:

	Thought Level		
	Level I	Level II	Level III
High participation	E	C	A
Low participation	F	D	B

The observed frequencies (0) of the children falling into the six categories and the expected frequencies (E) based upon chi square calculations are presented in Table 19.

TABLE 19

THE OBSERVED (O) AND EXPECTED (E) FREQUENCIES OF CHILDREN FALLING INTO THE SIX CATEGORIES OF PERFORMANCE FOR EACH OF THE FOUR DISCUSSIONS

			DISCUSSION							
			#1		#2		#3		#4	
		Category	O	E	O	E	O	E	O	E
Thought Level III	High Participation	A	68	54	47	38	62	47	39	30
	Low Participation	B	41	55	40	49	30	44	15	24
Thought Level II	High Participation	C	21	15	59	58	66	62	69	61
	Low Participation	D	9	15	74	75	54	58	42	50
Thought Level I	High Participation	E	89	109	54	64	63	82	60	77
	Low Participation	F	129	109	93	83	96	77	81	64

Chi square tests were performed and gamma correlation coefficients were computed for each of the four discussions. These yielded the following results:

Discussion 1 (N=357 students) chi square = 19.33 $P < .01$ gamma = .39 $P < .05$

Discussion 2 (N=367 students) chi square = 6.58 $P < .05$ gamma = .22 $P < .05$

Discussion 3 (N=371 students) chi square = 18.86 $P < .01$ gamma = .37 $P < .05$

Discussion 4 (N=306 students) chi square = 16.67 $P < .01$ gamma = .40 $P < .05$

In all four discussions, there were significant positive correlations between level of thought and the degree of participation. Chi square tests indicated that the frequencies of children falling in the "high participation--high and middle thought level categories" and the "low participation--low thought level category" exceeded the expected number. This relationship brought about the positive gamma correlations, all of which were significant.

It is thus evident that in every discussion the high participators were also producing the higher levels of thought; likewise, the low participators responded at the lower levels of thought. This may be caused by the fact that the children who think on the low level refrain from expressing themselves or else that the opportunities to participate were closed to them as the thought moved to levels at which they could not perform. It is also possible that the teachers inadvertently favored the high level thinkers and, therefore, offered them opportunities to participate more frequently.

But, these findings seem to confirm the theoretical point that intellectual functioning develops with activity and, therefore, the children deprived of this opportunity may actually fail to develop higher levels of thought. Furthermore, considering the significance of the rotation and pacing of assimilation and accommodation, it is quite possible that some children never entered the accommodation phase because the assimilation phase was always too short for their needs.

RELATIONSHIP OF SCORES ON SOCIAL STUDIES INFERENCE TEST TO PERFORMANCE IN CLASSROOM DISCUSSIONS

The other criterion measure developed for this study was the Social Studies Inference Test. This test measured at least in part the same cluster of cognitive skills that were exhibited in Discussions 2 and 3. However, the content of the test and the specific behaviors which it measures differs from those coded in Discussions 2 and 3. In that sense, these two represent independent measures. To determine the relationship between the Social Studies Inference Test and performance in classroom discussion, the children in each of the classes were divided into high and low scorers on each of the four subtests of the Social Studies Inference Test and chi square tests were performed between the frequencies of high scorers on the test as related to performance in discussions. The results of each of these tests are presented in Table 20.

TABLE 20

CHI SQUARE VALUES COMPUTED USING THE FREQUENCY OF HIGH SCORERS ON THE SOCIAL STUDIES INFERENCE TEST AND PERFORMANCE DURING THE CLASSROOM DISCUSSIONS. (2 x 3 MATRIX)

	Social Studies Inference Test							
	Pre-test				Post-test			
	I	D	C	OG	I	D	C	OG
Discussion #1	n.s.	n.s.	n.s.	n.s.	16.90**	15.46**	n.s.	n.s.
Discussion #2	n.s.	n.s.	n.s.	n.s.	n.s.	n.s.	13.74*	n.s.
Discussion #3	n.s.	n.s.	n.s.	n.s.	15.36**	14.40*	n.s.	n.s.
Discussion #4	n.s.	24.60**	n.s.	n.s.	53.86**	n.s.	13.94*	n.s.

* $P < .05$
** $P < .01$

n.s. - non-significant chi square values, indicating no relationship between performance in classroom discussion and scores received on the Social Studies Inference Test

The analysis of the relationship between the Inference scores of the Social Studies Inference Test shows that there was no relationship with the pre-test scores on Inference and the performance in any of the discussions. However, relationships exist between the performance on the discussions and the post-test scores on Inference. This may indicate that the teaching strategy and the content of the curriculum to which the children were exposed, had a decided effect on their performance in the classroom discussions as well as on their capacity to make inferences at the end of the school year. In any event, there is some indication that the children's performance during the classroom discussions involving interpretation of data (Discussion 3) and application of principles (Discussion 4) can be considered as a predictor of their performance on the Social Studies Inference Test.

Interpretation of each individual chi square test reported in Table 20 for each of the scores in the Social Studies Inference Test is given below:

Inference Scores

Pre-Test	The scores on the pre-test are not related to performance on any of the discussions.
Post-Test	Children who were high participators in Discussion 1 obtained high post-test Inference scores.
	Children who were high participators and had high thought levels on Discussion 3 obtained high post-test Inference scores.

Discrimination Scores

Pre-Test	Discrimination pre-test scores are not related to performance on Discussions 1,2, or 3.
	Children who were high participators on Discussion 4 obtained high pre-test Discrimination scores.
Post-Test	Children who were high participators on Discussion 1 obtained high post-test Discrimination scores.
	Children who were high participators and had high thought levels on Discussion 3 obtained high post-test Discrimination scores.
	Discrimination post-test scores were not related to performance on Discussions 2 or 4.

Caution Scores

Pre-Test	Pre-test scores on Caution are not related to performance on any of the discussions.
Post-Test	Children who were low participators on Discussion 2 obtained high post-test Caution scores. Children who were high participators but had low thought levels on Discussion 4 obtained high Caution scores.

Overgeneralization Scores

Pre-test and post-test overgeneralizations are not related to performance in any of the discussions.

Since Discussions 3 and 4 differed in the nature of the cognitive operations they required, the relationship between the children's performance on Discussion 3 and Discussion 4 and their post-test Inference scores was examined. Generally a process of research by which children accumulated data preceded Discussion 3 and the discussion focused on interpretating and generalizing from this data. The Social Studies Inference Test and Discussion 3 were similar in that both required examination of some data. As was predicted, the children with high post-test Inference scores were also high participators on the higher thought levels in Discussion 3. In Discussion 4, which requires application of principles and the projection of consequences from described conditions, (an hypothesizing form of thought involving a great deal of divergent thinking), the children who scored high on Inference also operated on the higher levels of thought, but were now low participators.

In contrast, children who operated on a low level of thought in Discussion 3 also operated on a low level in Discussion 4. Apparently, children who cannot do well in processing new information are also unable to think on a high level when faced with the more difficult task of applying this information and the principles derived from it.

In addition, 63% of the children who operated on high levels of thought in Discussion 3 gave low levels of thought in Discussion 4. This suggests the possibility that the sets of cognitive operations involved in the two discussions are quite distinct and that individuals who can interpret data do not necessarily perform on a high level when required to apply it and to do divergent thinking.

It is interesting to note that almost half (42%) of the low participators during Discussion 3 became high participators in Discussion 4. This may mean several things. One possibility is that the children whose previous experience habituated them to looking for right and wrong answers, but who were at the same time inadequate in processing data, brought the same set to the interpretation of data discussion because this cognitive task involves a certain amount of constraint in terms of the data given. In contrast, predicting in Discussion 4 calls for a rather divergent, less constrained cognitive activity to which these habits do not apply. These situations, therefore, may have permitted these same students to employ a freer set.

This hypothesis is further supported by the fact that forty-five percent of the children who responded on a high thought level during Discussion 3 had low scores on Caution on the post-test, whereas 52% of the high thought level children on Discussion 4 had low Caution scores. Apparently there is a greater tendency for the less cautious children to respond on a high level of thought during a discussion which offers freedom to hypothesize and to make predictions (Discussion 4) than they show when required to process data and draw inferences (Discussion 3). That is, children with a greater inclination to avoid risk taking tend to perform better in situations that involve less constraint, presumably because these situations do not touch off their usual "set".

RELATIONSHIP OF IQ TO PERFORMANCE IN DISCUSSIONS

The relationship of the IQ's of the children to their performance during the four classroom discussions was determined by chi square tests. All these tests were non-significant, indicating that the intelligence of the children is not related to the amount of participation or to the level of thought.

This means that there are a number of children with low IQ who think on a fairly high level, and a number of high IQ students who think on a low level. For example, two children, one with an IQ of 128 and another with an IQ of 76, were found performing on the high thought levels and with the same frequency.

This absence of the relationship between the IQ and the level of performance in discussions could possibly be accounted for in part by the fact that a proportion of students with low IQ's refrained from participation. In order to ascertain whether this was the case the non-responders were divided into High Low IQ groups and a chi square test was performed between the number of "no responders" in each of the groups for each class discussion.

In grades 3, 4, and 5 there was no significant difference between the frequencies of the "no responders" falling into the High and Low IQ groups. Only at the sixth grade level there were significantly more ($\chi^2 = 5.78$, df = 1, $P < .05$) responders in the high IQ group than in the low IQ group. It is not entirely clear to what extent this is a function of the accuracy of the IQ scores, of a difference in the type of cognitive functioning measured by IQ and that tapped in these discussions, or of the effect of teaching strategy in releasing the functioning intelligence of the so-called low IQ students. This latter seems a possibility because the teaching strategy and the question sequences included lingering on one level long enough to include as many children as possible. Further studies on larger number of students could bring a clearer answer to this possibility.

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CHAPTER IX

CONCLUDING OBSERVATIONS

By way of conclusion some observations are in order. These observations are addressed to three different facets of the study: 1) the growth in students' thinking, 2) the relationship of the mastery of thought to ability, achievement, social status, and 3) the impact of teaching strategies on the development of thinking.

Both criterion tests gave evidence of a fairly rapid maturation of thinking. The data from the Social Studies Inference Test showed that these students grew in their ability to differentiate data and to make inferences. Generally, students who started as good data discriminators became better inference makers at the end. Evidently, as was postulated, data discrimination is a skill which is a prerequisite to performing the more sophisticated operations of inference making. At the same time, the tendency to be cautious or to draw less from the data than is legitimately possible was reduced, but the tendency to overgeneralize remained the same.

This lack of change in the total group is spurious, because it is composed of two contrasting changes in individuals. One is the tendency for persons with an initially high ability to make inferences and a high tendency to overgeneralize to reduce the latter as they became more skilled in processing data, while retaining their high status as inference makers. In contrast, students with an initially low ability to make inferences began to overgeneralize at the end of the year. This shift towards more frequent overgeneralization seems natural in the light of special non-linear developmental transformations. Generally speaking, inability to make inferences seemed to be caused either by low skill in processing data, lack of a model for going beyond what is given, or by fear of taking risks in going beyond data. In such a sequence of development the first step for the poor inferencers is to overcome any of the three above-mentioned deterrents to inference making. Since at this point they lack sufficient skill in processing data, the first result is a tendency to overgeneralize. As further skills develop they eventually become adept at recognizing the limits of the data and, therefore, also at making increasingly valid inferences.

The data on growth from the analysis of the changes in the level of thought in classroom interaction were less clear, chiefly because the performance on each cognitive task was recorded only once and at a different point during the year, and, consequently, also at a different stage in the training of the students. Hence, no direct comparisons of the same type of cognitive operations at the beginning and at the end were possible. In addition, the cognitive tasks themselves were of different levels of difficulty, and approximately in the order in which they were taped. Presumably, the task of grouping and categorizing was the least difficult, at least on the level of generality and abstractness reached in these discussions. Formulating generalizations from interpreting data from various sources seemed to make greater demands on cognitive skills, especially if the comparison of several sets of data was involved. The last task, that of applying generalizations and facts acquired in previous study to hypothesize on the consequences of certain conditions in new situations, appeared to be the most demanding. The data indicated a gradual reduction of the top level thought units from the first to the last discussion. Without knowing what the differences in the difficulty of the three cognitive tasks were it was impossible to determine precisely the meaning of this reduction.

The comparison of the number of thought units on Level III, which combined the frequencies of formal thought on all three cognitive tasks (Chapter VIII, p.156), gives information on the progression in the transformation of concrete thought into formal thought from grade to grade. This level includes thought units which express the ability to handle abstract symbolic relationships and fairly high-level categorizations, to make valid inferences from data, to deal with the logic of the "if-then" principle, to project hypotheses, and to rationalize these projections by setting up both the logical and informational parameters.

Considerable growth in transformation of concrete thought into formal thought is indicated from the second through the sixth grade. Formal thought begins in a small way in the second grade. Its frequency increases slowly until in the fifth and sixth grades it represents approximately one-sixth of all thought units. These data indicate an earlier beginning of formal thinking than has been suggested by studies of untrained or meagerly trained children. These data thus affirm the developmental sequence described by Piaget but not its age placement. Formal thought appears and reaches a fairly high proportion earlier than is usually assumed. Without explicit comparative data on similar but untrained groups it is, of course, impossible to demonstrate that this acceleration is caused by training. It seems plausible, however, that the double impact of the curriculum which included an inductive developmental sequence of learning experiences and of teaching strategies, which followed the sequential steps in the mastery of the requisite cognitive skills, was an important factor. At least there were observable differences in the progression of thought in classes under highly skilled teachers and in the classes in which the requisite sequences were managed less adequately.

These data suggest certain possibilities, both for the theoretical conceptions of the development of thinking and for the methodology of studying it. First, it seems that it is more fruitful to view the development of thought as a continuous stream than as an additive accretion of specific skills. Second, instead of conceptualizing the development of thought as a straight linear growth in a single skill or operation, it seems more fruitful to see it as a series of transformations, such as the transformation of an initially poor inferencer, first into an overgeneralizer and then into a valid inferencer. In such a sequence the characteristics of caution and overgeneralization also acquire a different meaning depending on the point in the development at which the phenomenon occurs. For example, the shift to overgeneralizing on the part of the students with a habit of "sticking to the immediately given" may be considered a sign of growth rather than a sign of weakness.

There is also the question of time required to complete such a cycle of growth: to transform a poor data discriminator, a student with no model for going beyond data, or one who is fearful of taking the risk of doing so, into one who not only attempts to make inferences but also has the requisite skill. The current study supplied no evidence on this score. It is possible, however, that one school year is too short to reflect the whole cycle. Longitudinal studies of sufficient duration seem to be indicated to determine the nature of these transformations, the meaning of each at a given point in a sequence, and the time required to complete the cycle.

The evidence of the study also substantiates the hypothesis that an adequate emphasis on concrete operations of thought is a necessary prerequisite for the emergence of formal thought. The transition from the concrete to the formal mode of thought does not seem to be a mysterious, spontaneous phenomenon, but something that can be analyzed and aided by a conscious teaching strategy. However, further studies are needed to determine the nature of the concrete operations required to create a maximum opportunity for making this transition and to ascertain the differences in the nature and the duration of this preparation according to ability, age, and grade level. The data in this study indicate only that the age and the grade level was a factor over and above the training factor.

Perhaps the most startling finding of the study was the generally low relationship between the level of thinking and any of the traditionally influential variables: intelligence, achievement in social studies, reading comprehension, and social status. Generally low positive correlations were obtained between the level of intelligence and the level of performance in both the Social Studies Inference Test and the classroom discussions. This lack of relationship was still more marked when growth, as measured by change scores on the Social Studies Inference Test, was compared with the level of intelligence. Students with low IQ's gained as much in cognitive skills measured in this study over the year as did the students with high IQ's. There was no relationship in this gain to either social studies achievement or reading comprehension. Only the Discrimination scores, which reflect the ability to differentiate points in the given data, were related to reading. This indicates that reading level is a factor in understanding the test situation. It does not, however, influence and processes of making inferences or the functioning of overgeneralization and of caution.

Such a finding in a way substantiated one of the hypotheses of the study: namely, that the slow learners would be capable of abstract thinking under a program of instruction which paced assimilation according to their needs and provided sufficient opportunity for concrete operations before making a transition to abstract operations and symbolic content. Previous empirical evidence had suggested that a considerable proportion of the so-called slow learners were capable of abstract thinking, but were slow at assimilating the necessary material. Experience with such students has suggested also that the usual teaching strategy tends to burden these students with too much material and paces its mastery too rapidly to give them a chance to develop either an expectation of or skill in cognitive processing of this material.

Nevertheless, because such a finding contradicts what is usually expected and found, it is almost embarrassing in that it intensifies the questioning of the validity and stability of the measures used. Chapters VI and VII pointed out that while the criterion measures were by no means perfect they were about as adequate as any similar measures. They were reasonably valid and stable. In addition, the evidence from the two different measures was sufficiently consistent and substantial to suggest that the program disturbed the usual correspondence between ability and cognitive performance. The curriculum or the teaching strategies, or both, seems to have released a new dynamic that permitted students of low ability to function on a high level of thought and the intellectual performance that was required must have touched on some disability among the students of high IQ.

The most marked single influence on cognitive performances seemed to reside in the impact of the teaching strategies. This impact is exercised in a variety of ways: by the nature of the questions asked, what the teacher gives to the student or seeks from him, the timing of these acts in the total sequence, which ideas are picked up for elaboration and which are passed over, etc. Among these the nature of the questions asked seemed to play an especially influential role. The examination of the tapescripts and of the "flow-charts" describing the sequences of teaching functions and their effect on student performance leaves no doubt that the nature of the questions has a singular impact on the progression of thought in the class. The questions teachers ask set the limits within which students can operate and the expectations regarding the level of cognitive operations. Questions are the carriers of whatever new cognitive system is emerging. Some questions function as invitations to heighten the performance of certain cognitive operations, while leaving the content and the directions of these operations open. Such questions invite invention, discovery, and the creative use of previous knowledge. Others control and limit both the content and the nature of cognitive operations. Such questions dictate both what the students are to think about and how they are to go about it, thereby limiting both the level and the nature of thought. Still others control the content but give no guidance as to the kind of operation expected. Such questions either lead the students to the lowest level of operation or set them to guessing what the teacher has in mind. Both the inspection of tapescripts and the data comparing teaching functions with the level of thought among students leave no doubt that teachers get in proportion to what they seek. Those who seek formal thinking more frequently also get it more frequently.

It is evident, further, that the attained level of thinking is influenced not only by the nature of the single act just preceding a student response. The whole pattern of teacher acts determines the level of response attained: the particular combination of focusing, extending, and lefting; the timing of these acts in the sequence; and the pacing of assimilation and accommodation. The latter seems to be an especially influential ingredient of effective teaching strategy. For example, if the teaching strategy provides an appropriate length of time for assimilation and employs adequate pacing in transforming concrete thought into formal thought, even children of low ability can perform on an abstract level with a frequency equal to that of high ability children. It seems, then, that mature thought can be brought about in all kinds of students, provided teachers know what they are about, use appropriate teaching strategies, and have the needed skills.

These observations, of course, raise a host of questions for further study. If the development of cognitive autonomy is to be a realistic objective, a much more thorough study of and experimentation with teaching strategies is needed. It would, for example, be important to examine more carefully how certain of the teachers' questions or statements function: which particular questions and statements open up or close the thinking of students; what role the setting of the parameters for prediction and hypotheses plays; what particular acts or sequences and combinations of acts lead to acquisition of open or closed conceptual structures; etc. Further, examination is needed also of the role of the two cognitive maps and the teacher's mastery of them in the productivity of teaching strategy. These two cognitive maps are the structure of the content and the structure of the dynamics of the operations involved in the three cognitive tasks.

A weakness in either is bound to result in defective teaching strategy.

Future studies also need to add another dimension of analysis of classroom interaction, that of the significance and validity of the content of the thought patterns. It seems highly important to make provisions for assessing the validity of the content of inferences, predictions, and generalizations, in addition to assessing the level of the process itself. This study has pointed up the need for a four-dimensional analysis of classroom interaction: 1) of the pedagogical functions of teacher behavior; 2) of the logical hierarchy of the thought processes; 3) of the validity of significance of the content of these processes; and 4) of the impact of each on all the others.

The experience of this project suggests the need for measures of thinking which tap not only the end products of thinking but also record the processes students use to arrive at their answers. Studies of thinking will remain defective as long as they focus only on the nature and quality of inferences, predictions, and of relationships perceived by the students. The center of the dynamics of thought seems to lie beyond these end-products; namely, in the processes individuals employ in arriving at them. Much remains to be done in describing these ways of arriving at the answers required in tests or classroom discussions. The meager amount of experimentation undertaken in this study revealed distinct differences in the ways in which individual students decided whether the inference was probably true or false. Differences were found, also, in the degree to which "can't tell" was an attractive alternative. In many cases the cognitive habits developed in the usual "get the right answer or else" style of teaching and learning seemed to prevent the use of this type of response. It remains to be determined to what extent these differences are a matter of acquired cognitive styles and to what extent they are influenced by personality factors, such as an attitude toward risk taking and ambiguity.

The above problems call for a greater attention to the relationships of the affective and cognitive factors in thinking. They also call for far more sensitive testing tools than have been available so far. There is a special need for instruments and devices which tap the processes that underlie the formation of such products of thought as inferences, generalizations, and hypotheses. To measure these processes would probably require instruments which employ visual forms of presenting test situations and mechanical devices for recording both the answers and the methods of arriving at them. Such instruments would solve two problems which have plagued evaluation of thinking. One is the contamination of the results of tests on thinking with reading difficulties. The testing of thinking, even on a moderate level of complexity, requires long verbal descriptions which makes reading ability a potent factor in understanding test problems. This fact has made it practically impossible to use group testing of thinking in primary students and students in higher grades with reading difficulties. If the assessment of thinking is to be extended to these groups of students, experimentation with non-verbal presentation of test situations becomes a necessity. Modern technological equipment, such as the multi-media teaching systems, and computer-based programmed presentations which record student responses, eliminates these difficulties and enables the researchers to replace individual interviewing with group testing on a wider scale.

Reorganization of the analysis of results is needed also. Although the development of computer programs for use in research has opened up new vistas, classroom interaction is far too complex to be analyzed effectively by existing programs of data processing. The problem of determining and analyzing the intricate combinations and sequences arises as one goes beyond the analysis of frequencies of single acts. In effect, here one deals not only with patterns but with patterns upon patterns. Hence, the problem of developing computer programs which can reflect these intricacies is a key to studying the relationship of teaching strategies to the performance of the students. Until now the studies of the styles of thought and of the impact of teaching strategies upon these patterns have used, it seems, too simple a paradigm of the essential nature of either, not to mention the impact of the one upon the other. The simplicity of the paradigms may, in fact, be dictated by the assumption that it is impossible to analyze more complex data.

The cruciality of appropriate teaching strategies in affecting the cognitive functioning of children points to the increased need for careful examination of the kind of training teachers receive. Not only is it necessary to give teachers more intensified training; - it is also necessary that sharper materials be developed to make this training truly effective. It is a slow and sometimes impossible task to develop the kind of understanding of the dynamics of thought essential for this purpose by verbal descriptions alone. Examples of actual classroom transactions are needed to serve as models in order that teachers may understand clearly what is involved. It seems, therefore, that one important purpose of all experiments and studies should be to make selections of their records of classroom transactions available for training teachers. This would be of help not only to future studies but would also provide more adequate materials for teacher training in general.

The experience in the study also suggests that such training is vastly more effective when addressed not to general improvement in teaching but to definite strategies needed for specific purposes, such as cognitive development. Further, it is not merely a matter of acquiring a new bag of tricks. The teaching strategies described here require modifications of deeply ingrained habits, expectations, personal styles, and feelings. Therefore, teachers who are unfamiliar with this approach to teaching require a completely new frame of reference. This change in style of teaching cannot be accomplished in a short period of time, in a summer session course, in a workshop, or in an extension course. It does not come about by instantaneous learning. Teachers, like children, need opportunities for cumulative learning and time for assimilating the new modes of thinking about teaching and learning if they are to alter their current conception of their roles and their habits of teaching. Only by experience and extended practice over a period of time can teachers acquire a new model for understanding and enhancing children's thinking.

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APPENDIX A

SOCIAL STUDIES INFERENCE TEST

Grades 3-6

Explanation to Students:

This booklet has some stories. After each story there are some sentences about the story. First, I will read the story out loud to you and you can follow along in your booklet. Then I will read each of the sentences and you are to decide whether the sentence is probably true, probably false, or if you can't tell from the story whether the sentence is probably true or probably false.

You have five different colored cards. Take the white card first. You see on this card spaces for marking your answer.

Decide on an answer for each sentence that I read to you. Mark your answer with a heavy black mark. If you think the answer is probably true, mark in the space under "Probably True". If you think the answer is probably false, mark in the space under "Probably False". If you can't tell from the story whether the sentence is probably true or probably false mark in the space under "Can't Tell".

Some of the sentences are "Probably True" and some of the sentences are "Probably False". You can't tell if some of them are true or false.

Example:

> Mr. Jones was a farmer in the midwest. When he heard about the discovery of gold in California he left his family and went to California.
>
> 1. Mr. Jones went with his family to California.
>
> 2. Mr. Jones went to California because he did not like the place in which he lived.

Scoring:

The Social Studies Inference Test is composed of 68 items; 36 of which can either be scored as Inference (I) or Caution (C), 18 of which are scored Overgeneralization (OG), and 14 of which are scored Discrimination (D).

The key, presented to the right of each item, indicates the component of the Social Studies Inference Test which is scored if that alternative is selected. For example, if the student selects "Can't Tell" for item #1 he is credited with one point on the "Caution" component.

The third grade subjects were administered only the first 27 items; the fourth, fifth, and sixth graders were administered the total test.

Martha left her school friends and moved with her family to America. Soon after she got to America she started to school. On her first day at school the other children looked at Martha and talked about her. She did not speak to the other children, and at recess she sat alone and watched them play. She told the teacher that she was unhappy. When she got home from school she cried.

		Probably True	Can't Tell	Probably False
1.	Martha wanted to play with the other children.	I	C	
2.	Martha will make friends at this school.	I	C	
3.	Martha speaks English.	D		
4.	Martha will teach the children how to play some new games.	OG		
5.	Martha stayed home from school the next day.		C	I
6.	The teacher likes Martha.	OG		

Mr. Edwards' farm was in the valley. He had just finished planting his seeds. He could see the snow on the mountains. He hoped the snows would not melt too fast. The fire last summer burned most of the trees on the mountainside.

		Probably True	Can't Tell	Probably False
7.	More water will flow into the valley this year than last.	I	C	
8.	Mr. Edwards' seeds will die of frost.	OG		
9.	Topsoil from the mountain will be washed down into the valley.	I	C	
10.	Mr. Edwards planted his seeds after the snow fell.	D		
11.	Mr. Edwards will have enough water for his farm this year.	I	C	
12.	Mr. Edwards' farm is on the mountainside.			D

Mr. and Mrs. Koski remembered the day they docked in New York. They had been married only two months when they arrived from Poland. America was a strange land to them. Mr. Koski worked hard for many years so his children could go to school. Ed, the oldest child, is now in college and will one day become a lawyer.

		Probably True	Can't Tell	Probably False
13.	The Koskis spoke English when they first came to America.		C	I
14.	The Koskis came to America last year.			D
15.	Ed is proud of his father.	OG		
16.	The Koskis will return to Poland to live.		C	I

Pambo is twelve years old. There are no schools where Pambo lives. He does not read or write. He fishes with his father every day. Pambo is learning to cut wood from tree bark in order to make a canoe. His father teaches him many things and is proud of how well Pambo can do them.

Tom is also twelve years old. He works hard at school and gets good grades. When he comes home from school he reads his books so that he will learn things that will help him.

	Probably True	Can't Tell	Probably False
17. Tom is smarter than Pambo	OG		
18. Pambo's father can read and write.		C	I
19. Pambo is having trouble learning how to make canoes.			D
Pambo and his family are going to move to the city where Tom lives.			
20. Pambo will go fishing every day with his father.		C	I
21. Pambo will teach Tom how to make canoes.		C	I
22. Tom reads every day because he is behind in his school work.			D

Henry's father is a farmer. Henry is twelve years old. During the week Henry goes to school and he wants to become a teacher. On weekends he works on the farm and has learned to drive a tractor. His father is happy that Henry wants to become a teacher.

Taro is also twelve years old. Taro's father is a hunter. Taro's grandfather also was a hunter. Taro is learning to hunt from his father. Many times on the way home from hunting Taro stops to watch the fisherman. One day Taro asked his father, "Can I become a fisherman?" Taro's father said, "No, because I am a hunter."

	Probably True	Can't Tell	Probably False
23. Henry will become a teacher.	OG		
24. Henry's father wants Henry to become a farmer.			D
25. Henry's grandfather was a farmer.	OG		
26. Taro will leave the tribe and become a fisherman.		C	I
27. Taro's sons probably will become hunters.	I	C	

Three months after the Picker had been invented more flander had been picked than for all of the year before. All of the machines at the textile mills were working day and night. Six months after the Picker had been put to use the mills realized that they could not process the amount of flander sent to them.

	Probably True	Can't Tell	Probably False
28. Flander is a type of cotton.	OG		
29. The Picker will be used only three months each year.		C	I
30. Flander is one of the most important products of this country.	OG		
31. Flander is used in making cloth.	D		
32. The mills will change the way they process flander.	I	C	
33. Less flander will be grown next year.		C	I
34. The price of materials made of flander will go down.	I	C	

Mr. Harvey spoke to the Founders Club last night. Here is part of what he said:

> "In the early days of our country many people settled here from other countries. They came here to establish a way of life that was better than they had in their own countries. They helped build a strong America because they believed in America. Today the foreigners who come here do not seem to appreciate the freedom and opportunity America offers them. We ought to be more careful about who we let in and require an oath of these foreigners before we accept them."

	Probably True	Can't Tell	Probably False
35. Mr. Harvey feels that people who take an oath can be trusted.	D		
36. Mr. Harvey is against more people coming to America from other lands.	I	C	
37. Mr. Harvey believes the early settlers were good for America.	I	C	
38. Mr. Harvey has studied a great deal about America.	OG		
39. Mr. Harvey believes that people born in America are more loyal than people coming from other lands.	I	C	
40. Mr. Harvey believes that there are too many foreigners in America now.	I	C	
41. Mr. Harvey's grandfather was probably born in America.	OG		
42. Mr. Harvey is running for political office.	OG		

Thirty years ago Mr. Rand bought a thousand acres of farmland. Many new industries have developed in the city nearby. About ten years ago Mr. Rand sold half his farmland to people who build homes. Last year Mr. Rand sold two hundred acres more and many homes have already been built on this land.

		Probably True	Can't Tell	Probably False
43.	The people are coming to work on Mr. Rand's farm.		C	I
44.	They are building houses for the people coming to work in the industries.	I	C	
45.	Mr. Rand will sell the rest of his farmland to the people building homes.	OG		
46.	Mr. Rand still owns half of the farmland that he bought thirty years ago.			D
47.	Next year there will be more people working in industry.	I	C	
48.	Mr. Rand sold his farmland for more money than he paid for it.	I	C	
49.	They will need more schools.	I	C	
50.	The people who had worked on Mr. Rand's farm went to work for industry.	OG		
51.	The people who bought Mr. Rand's farmland were farmers.			D

People A:

The vote had been very close. A number of the representatives did not like the outcome. They decided to go back to their districts and appeal to the people for support. This was the fourth important issue on which the President had been defeated.

People B:

The Chief asked his council for advice and then he told his people what he had decided. The people listened to their Chief. When he was through talking they cheered.

		Probably True	Can't Tell	Probably False
52.	People A and People B have the same system of government.		C	I
53.	The representatives of People A are selected by the President.		C	I
54.	People A will re-elect the representatives who voted for the bills the President supported.	OG		
55.	People B vote on what the Chief wants to do.			D
56.	The Chief of People B knew his people would do what he says.	I	C	
57.	Most of the representatives of People A agreed on the issue that they had just voted on.			D
58.	People B vote for the members of the council	OG		

Mr. Jones owns a grocery store. Often, in the last few weeks, he has not had enough bread for his customers. It has been an unusually dry season in the area and the wheat crop has not done well this year.

	Probably True	Can't Tell	Probably False
59. The delivery trucks have broken down so Mr. Jones is unable to get bread.		C	I
60. There was as much rainfall this year as last year.		C	I
61. The bakers have been very busy this year.		C	I
62. Mr. Jones will start baking his own bread.		C	I
63. They are using the wheat to make other things this year rather than for making bread.		C	I
64. Mr. Jones will close his store until more bread is baked.		C	I
65. The wheat crop was of poor quality.	OG		
66. The price of bread is higher this year than last year.	I	C	
67. Mr. Jones will make less money this year than last year.	OG		
68. More wheat will be harvested this year than last.			D

APPENDIX B

EASE INDEX AND DISCRIMINATION INDEX FOR ITEMS ON THE SOCIAL STUDIES INFERENCE TEST

(Pre-Test Scores for Revised Scale)

(Pearson Product Moment Correlations)

INFERENCE SCALE				
	3rd Grade		4-5-6 Grades	
Item	EI	DI	EI	DI
1	26	22	55	26
2	63	48	44	21
5	20	34	25	31
7	22	36	32	36
9	40	38	60	38
11	58	44	61	32
13	38	44	40	31
16	25	36	41	48
18	30	24	47	42
20	32	28	68	41
21	23	10	22	28
26	40	50	43	43
27	52	60	43	38
29			44	24
32			30	29
33			37	37
34			32	44
36			28	18
37			40	22
39			53	30
40			37	33
43			51	41
44			63	27
47			56	52
48			33	34
50			61	34
52			60	33
53			30	29
56			54	33
59			77	43
60			51	26
61			59	50
62			43	40
63			62	41
64			57	42
66			38	38

DISCRIMINATION				
	3rd Grade		4-5-6 Grades	
Item	EI	DI	EI	DI
3	35	30	35	34
10	32	12	35	38
12	49	58	62	39
14	52	44	56	29
19	39	50	49	29
22	38	48	63	52
24	51	52	65	24
31			56	23
35			64	59
46			42	55
51			55	50
55			20	24
57			31	39
68			61	47

EASE AND DISCRIMINATION INDEX, continued

CAUTION SCALE

	3rd Grade		4-5-6 Grades	
Item	EI	DI	EI	DI
1	34	24	24	26
2	27	40	49	34
5	54	62	65	43
7	63	68	58	38
9	34	54	27	34
11	36	60	34	39
13	41	66	50	41
16	54	60	55	56
18	36	60	42	57
20	28	46	21	29
21	30	52	44	57
26	38	56	45	45
27	33	50	44	36
29			40	44
32			42	51
33			49	47
34			43	58
36			25	28
37			34	32
39			31	40
40			32	40
43			29	37
44			22	33
47			37	47
48			53	54
50			29	41
52			25	34
53			35	44
56			29	40
59			12	24
60			41	29
61			21	32
62			39	38
63			23	33
64			26	34
66			35	47

OVERGENERALIZATION

	3rd Grade		4-5-6 Grades	
Item	EI	DI	EI	DI
4	39	58	39	47
6	74	50	63	47
8	44	52	32	39
15	66	58	65	47
17	64	46	61	23
23	63	38	75	27
25	32	42	25	38
28			40	30
30			24	41
38			54	42
41			44	40
42			20	33
45			26	35
50			25	35
54			24	28
58			38	34
65			61	37
67			59	33

APPENDIX C PERCENTAGE OF THOUGHT UNITS GIVEN BY THE CHILDREN AT EACH COGNITIVE LEVEL

	TAPE #1					TAPE #2					TAPE #3					TAPE #4					TOTAL				
CLASS	N	O	I	II	III	N	O	I	II	III	N	O	I	II	III	N	O	I	II	III	N	O	I	II	III
21	123	17	60	7	15	138	20	57	20	4	163	4	77	15	4	122	32	45	21	2	546	17	61	16	6
22	93	6	39	37	18	87	10	67	15	8	52	4	71	17	8	109	14	67	18	1	341	9	60	22	9
23	60	0	75	0	25	83	4	54	33	10	116	5	61	30	3	110	13	52	35	1	369	6	59	27	8
TOTAL	276	10	56	16	18	308	13	59	22	7	331	4	71	21	5	341	20	54	25	1	1256	12	60	21	7
31	218	5	84	8	2	141	4	58	37	1	124	1	65	31	3	181	14	48	35	3	664	7	65	26	2
32	102	2	79	8	1	115	3	52	35	10	94	2	64	22	12	75	12	65	23	0	386	4	65	25	6
33	79	8	73	8	1	93	1	49	44	5	69	3	58	30	9	120	9	45	44	2	361	6	55	34	6
34	108	1	99	0	0	84	0	63	32	5	101	0	51	30	19	151	9	66	19	7	444	3	70	19	8
35	99	0	61	13	26	139	1	63	34	3	105	0	54	42	4	103	7	66	25	2	446	2	61	30	8
TOTAL	606	3	81	9	7	572	2	57	36	5	493	1	59	31	9	630	10	57	31	3	2301	4	64	26	6
41	88	2	93	1	3	126	0	60	32	8	104	0	54	43	3						318	1	67	27	5
42	83	2	40	0	58	110	1	57	37	5	134	0	81	19	0	138	12	59	20	9	465	4	62	20	14
43	43	0	100	0	0	67	0	64	22	13	89	1	62	37	0	85	6	72	21	1	284	2	71	23	4
TOTAL	214	2	74	0	24	303	0	60	32	8	327	0	67	32	1	223	9	64	20	6	1067	3	66	23	9
51	42	2	81	0	17	138	0	36	55	9	152	2	50	34	14	183	5	38	39	18	515	3	45	38	14
52	67	1	51	0	48	100	0	60	28	12	69	1	52	25	22	151	6	62	25	8	387	3	58	21	18
53	44	0	93	0	7	66	2	42	53	3	101	5	61	24	10	118	21	63	14	3	329	9	62	23	5
54	39	0	56	0	44	98	2	56	39	3	81	2	62	28	7	58	12	59	24	5	276	4	58	27	11
55	53	2	90	0	10	132	0	44	33	13	203	1	9	67	23	201	10	38	43	8	589	4	34	48	14
TOTAL	245	1	73	0	26	534	1	47	44	9	606	2	40	41	17	711	10	49	32	9	2096	4	49	34	13
61	146	0	45	0	55	144	1	51	38	10	409	0	53	33	13	159	4	45	37	14	858	1	50	30	20
62	104	2	53	0	45	77	3	21	44	32	58	0	21	38	41	134	19	28	43	10	373	8	32	31	29
63	104	2	50	0	48	92	1	33	42	24	101	0	4	59	37	133	7	70	19	5	430	3	41	29	27
64	186	0	61	1	38	151	0	62	33	5	168	0	42	46	11	118	6	60	31	3	623	1	56	27	16
TOTAL	540	1	53	0	46	464	1	46	38	15	736	0	41	40	18	544	9	50	33	8	2284	2	47	29	22
TOTALS	1881	3	67	5	24	2181	3	53	36	9	2493	1	52	35	12	2449	11	53	29	6	9004	5	56	27	12

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APPENDIX D PERCENTAGE OF THOUGHT UNITS SOUGHT BY THE TEACHER AT EACH COGNITIVE LEVEL

	TAPE #1					TAPE #2					TAPE #3					TAPE #4					TOTAL				
CLASS	N	O	I	II	III	N	O	I	II	III	N	O	I	II	III	N	O	I	II	III	N	O	I	II	III
21	62	2	27	19	52	62	5	63	32	0	96	1	73	25	1	44	14	57	27	2	264	4	57	26	13
22	37	5	24	54	16	48	6	67	25	2	27	0	70	26	4	68	9	78	13	0	180	6	63	27	4
23	29	0	41	0	59	46	0	46	54	0	65	0	55	45	0	85	1	56	39	4	225	0	52	39	9
TOTAL	128	2	30	25	43	156	4	59	37	1	188	1	66	32	1	197	7	64	27	2	669	3	57	30	9
31	50	2	84	4	10	62	5	66	29	0	47	19	26	53	2	93	4	59	37	0	252	7	60	31	2
32	44	2	75	20	2	83	1	49	48	1	60	0	80	18	2	61	5	75	20	0	248	2	68	29	1
33	44	2	70	23	5	45	0	33	62	5	32	0	59	34	6	75	3	40	56	1	196	2	48	46	4
34	68	7	90	0	3	41	0	56	37	7	35	0	31	60	9	21	0	33	57	10	165	3	62	29	6
35	63	6	41	22	30	90	0	53	47	0	48	0	46	54	0	49	2	53	39	6	250	2	49	40	9
TOTAL	269	4	72	13	11	321	1	52	45	2	222	4	50	42	3	299	3	55	40	2	1111	3	57	35	4
41	31	10	77	6	6	43	0	49	49	2	45	0	47	53	0						119	3	55	39	3
42	47	0	70	0	30	37	0	41	59	0	52	0	79	21	0	71	1	83	15	0	207	0	71	21	7
43	5	0	60	0	40	24	0	63	29	8	48	0	50	50	0	32	0	94	6	0	109	0	66	30	4
TOTAL	83	4	72	2	22	104	0	49	48	3	145	0	59	41	0	103	1	86	13	0	435	1	66	29	5
51	32	0	72	0	28	66	0	33	65	2	92	0	58	36	7	108	2	56	36	6	298	1	53	39	7
52	3	0	67	0	33	21	19	57	24	0	19	0	53	47	0	26	0	88	12	0	69	6	68	25	1
53	14	0	93	0	7	25	0	32	60	8	51	0	67	20	14	56	7	80	13	0	146	3	68	22	7
54	11	0	64	0	36	67	7	43	52	1	47	0	55	43	2	49	2	55	31	12	174	2	51	40	7
55	7	0	86	0	14	29	3	14	83	0	59	0	14	61	25	121	2	34	55	9	216	2	27	58	13
TOTAL	67	0	76	0	24	208	3	36	59	2	268	0	49	40	11	360	3	55	36	6	903	2	50	40	8
61	94	3	24	0	72	30	3	30	63	3	273	0	56	36	8	54	2	46	44	7	451	1	47	31	21
62	49	4	49	0	47	26	0	46	42	12	21	0	29	38	33	7	14	43	43	0	103	1	47	31	21
63	28	0	54	0	46	44	2	20	68	9	44	0	7	66	27	37	0	78	22	0	153	1	37	44	19
64	68	1	53	0	46	100	0	69	29	2	105	0	51	44	5	47	0	74	26	0	320	0	61	27	12
TOTAL	239	3	41	0	56	200	1	50	45	5	443	0	49	41	10	145	1	63	32	3	1027	1	49	31	19
TOTALS	786	3	56	9	32	989	2	49	47	2	1266	1	53	40	7	1104	3	61	33	3	4145	2	55	34	10

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APPENDIX E

MANUAL FOR CODING CLASSROOM DISCUSSIONS

This manual presents the scheme used in coding transcripts of classroom discussions. In this scheme, each thought unit is coded for both the teacher and the child. A thought unit may include several sentences or may be only a part of a sentence. Each separate thought unit is coded by the following code system.

The coding of a thought unit always consists of two parts and may consist of three parts. These parts are:

1. The identifying codings. This coding identifies the person making the statements and also indicates whether the person is giving information or seeking information. There are four types of identifying codings:

CODE:	
CG	Child gives
CS	Child seeks
TG	Teacher gives
TS	Teacher seeks

2. The thought level codings. These codings identify the level of thought contained in the thought unit. Within each thought level there are three codings: in the units place of the code the zero (0) code indicates a thought unit that is irrelevant or incorrect; the one (1) code indicates a correct response at that thought level without elaboration; the two (2) code indicates a correct response at that thought level which is accompanied by some qualifying or explanatory statements.

   The coding scheme for the cognitive task of predicting consequences contains an additional code in the units place for prediction. This three (3) code is used to designate a prediction accompanied by a stated or implied principle.

Cognitive task: Grouping and labeling*

(giving or seeking)

10	specific or general information outside of focus
11	specific or general information within focus
12	specific or general information with qualifications

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* Categories in the 20 series were originally reserved for "general information" but were later combined with the 10 series.

30	grouping information without basis
31	grouping information with implicit basis
32	grouping information with explicit basis
40	categorizing information without basis
41	categorizing information with implicit relationships between items
42	categorizing information with explicit relationships between them
Cognitive task:	interpreting information and making inferences:
	(giving or seeking)
10	specific or general information outside of focus
11	specific or general information within focus
12	specific or general information with qualifications and relationships
50	specific reason or explanation that does not relate to the information
51	specific reason or explanation that relates or organizes the information
52	specific reason or explanation that states how it relates or organizes the information
60	irrelevant or incorrect inference which is derived from information
61	relevant inference which is derived from information
62	relevant inference which is derived from information and expresses a cause and effect relationship, explanation, consequence, or contrast
70	relationship between information which implies an irrelevant or incorrect principle or generalization
71	relationship between information which implies a principle or generalization
72	principle or generalization which is derived from information
Cognitive task:	predicting consequences
	(giving or seeking)
90	correcting the cause or condition

Establishing parameters of information

100	relevant information
101	relevant information for establishing the parameter for a particular hypothesis or prediction
102	relevant information for the parameter or any particular prediction with appropriate explanation

Establishing parameters of conditions

110	irrelevant or untenable condition for the logical parameter (if-then) or for the particular prediction or hypothesis
111	relevant condition without connecting it with relevant information
112	relevant condition and information and establishing logical connection between them

Prediction: Level one (100), immediate consequences
Level two (200), remote consequences

120-220	incorrect or out of focus prediction
121-221	prediction with no elaboration
122-222	prediction accompanied by explanation, qualification, differentiation, comparison, or contrast
123-223	prediction accompanied by a stated or implied principle

To determine the statement coding, each thought unit is first judged and coded according to its level of thought (whether in the 10's, 40's, 60's, etc.) and then is coded as 0, 1, or 2, depending upon the relevancy and complexity of the thought unit.

3 The function coding

The function codings are used to describe teaching strategies which affect subsequent thought. Not all statements receive function codings. When function codings apply, they are placed to the right of the thought level coding. Six function codings are used directly with identifying codings, and do not require thought level codings. Below are listed the function codings, along with examples of each.

A Agreement - agreeing with the content of a statement

Yes, that's right, John.
That's correct, Sue.
Okay. We'll accept that.

AP Approval - approving of individuals of the class for their contribution to the discussion

Oh. That's very good, Jean.
Uh-huh. Yes, that is a very good point, Hank.
You did a very good job with the discussion today, class.

D Disagreement or correction - disagreeing with the content of a statement

No, Ted, I don't think the aborigines were there at the time.
I don't think you're right, Janie. I don't agree with you at all.
That's not quite accurate, Betty. The aborigines were there before the Europeans came.

DP Disapproval - disapproving of the individual or the class for their contribution to the discussion

That wasn't a very good job of grouping those tools, class.
You are not thinking very clearly today, Jim.
We'll have to do better than that, boys and girls. We're not doing our job.

M Management - a question or statement that regulates the classroom activities or directs the course of the discussion

We'll have to take our turns, and wait for the other fellow to finish before we take our turn.
It's almost the end of the hour, class. We have quite a long list here now. That's quite enough, I think.
Will you please help him out, Ned. Thank you.

R Reiteration - repetition of what has previously been stated

Sam says, "Hammers and nails." All right, Joe, anything else?
Henriette says that all of the sailors on board got scurvy because they didn't have any citrus fruit on board ship.
Someone just said that is they have enough water they won't have to move around as much.

The following function codings are used in conjunction with both identifying codings and thought level codings:

F Focus - a statement or question that provides the topic of the discussion

Today, class, let's see whether we can list all of the building materials that a house is made of.
Now we are going to discuss a make-believe situation. Suppose America suddenly discovered a large, beautiful island out in the Pacific Ocean close to California. Suppose word leaked out that there was gold on this island. What do you think might happen?
Let's talk first about what happened in the movie of the African Girl we just saw.

FR Refocus - a statement or question that returns the classroom to the topic under discussion

Remember now, we are talking about the beef industry in the Argentina. Let's not get this confused with the people who have dairy cattle.
(Child has given "hammer" as a building material) Now think carefully--is that actually part of the house? What exactly is the house itself made of, the parts that stay as the house when the workers go away?
Let's get back to the original question. What were some of the changes that have been brought about by people coming to America from other lands?

FC Change of Focus - a statement or question that changes the topic under discussion

Now that we've listed as many building materials as we can think of, let's try to list some tools that carpenters might use in building houses.
You have said that there would be a great change in the way of life at the missions. How would this affect the manner in which they trade with others?
We've talked about the immediate changes that would come to the island if we came over. What do you think would occur on the island if we had lived for a while with these people?

FD Deviation from Focus - a statement or question that causes the class to stray from the discussion topic

(Topic under discussion is materials used in building houses). Just red clay brick like those down at the old firehouse. It's pretty, isn't it? Does anyone know how long that old firehouse has been there?
They could go to the island by airplane. Have any of you ever been up in an airplane?

X Extension of Thought Levels - a question or statement which functions as an extension whenever the teacher or child seeks or gives additional information on the same level of thought which is for the purpose of elaboration or clarification of information already provided.

L Lifting of Level - a question or statement which functions to lift the level of thoughts whenever the teacher or child seeks or gives information that changes the level of thought to a higher level than had previously been established.

Relationship of X and L Codings

In determining whether or not a thought unit is functioning to extend or lift the level of thought, the thought unit must be considered in context. It is possible that a question asked in one context can function to extend the thought, and in another context can function to lift the thought level, as is shown in the following example:

1)	C	They were working fast on the house.	CG	11	
2)	T	Why?	TS	51L	Reason
3)	C	They wanted to get the house done before the rain came.	CG	51L	Reason
4)	T	Why?	TS	51X	Reason
5)	C	Because unless it is finished, the rain will destroy it.	CG	52X	Reason

The inquiry on line 2 is coded as teacher seeks to lift level of thought from established level of 11 to the higher level of 51. On line 3, the child responds with the reason that functions to lift the level of thought according to the teacher's request. The inquiry on line 4, which is the same inquiry as on line 2, now functions to extend the thought, because the level at which the question is asked has already been established by the previous statement. The response given on line 5 also functions as an extension according to the teacher's request. Thus, it is possible for the teacher's request for a reason, by asking "Why?" to function as seeking an extension or as seeking to lift the level of thought. Also, the reason that is provided in the child's response may function either as an extension, or as lifting the thought level, depending upon the context within which it is given.

In the following example, the teacher's request for an inference (line 3) does not represent an attempt to change the level of thought, because it has already been established at the inference level. The request for an inference in this case functions as an extension of the original inference.

1)	T	Did they have to have any special skills to know how to build this house?	TG TSA	61
2)	C	Yes.	CGA	
3)	T	Explain why.	TS	61X
4)	C	They had to learn how to get the mud, get the bamboo, and chop it.	CG	62X

In the following case, the teacher attempts to lift the level of thought from giving information to making an inference. The teacher's request is coded L and the child's reply is also coded L. In this case, the teacher seeks to lift the level of thought, and the child responds accordingly.

1)	C	They carried things in baskets on their heads.	CG	11
2)	T	Explain why.	TS	61L
3)	C	I suppose they can carry more things that way.	CG	61L

The person seeking to lift the level of thought must, by definition, receive a statement code in a higher category than that which precedes it. Only the person who seeks to lift the level of thought receives the L coding. Likewise, only the person who provides a thought unit that lifts the level of thought may receive the L coding. Other subsequent thought units that are on the same level, or on a lower level, receive the X coding if the statements function to extend the thought. The changing of levels in categories such as from 41 to 42, or 61 to 62, do not function to lift the level of thought as they are within the same category. These may, however, function as extensions.

Although the X (extension) coding is utilized for statements that elaborate or add to a statement that has been made previously, it is not used for separate, unconnected statements, even though the statements all relate directly to the topic under discussion, as follows:

1)	T	Does anyone remember how the women carried things?	TS	11	FC
2)	C	On their heads.	CG	11	
3)	T	Well, now, how do you suppose they carried these things on their heads? Everybody stop and think - why, as they went to market, were they all carrying things on their heads?	TS	51	L

4)	C	Their hands get tired.	CG	51	L
5)	T	Yes, their hands might get tired, but there are other reasons, too. Can you think of any other reasons?	TGR		
6)	C	Baskets might be heavy.	CG	51	
7)	T	Yes, any other reasons?			
8)	C	They don't have any bags.	CG	51	
9)	T	They didn't seem to have any bags. Didn't see any, did we? Any other reasons?	TGR		
10)	C	They had so many things - they can get that on their head and carry them in their hands.	CG	51	

The teacher's inquiry on line 3 seeks to lift the level of thought from the informational level (11) to the reason level (51) and therefore receives the function coding L. The children's responses on lines 6, 8, and 10, while relating directly to the question asked by the teacher, are not considered extensions of a thought but rather are separate, unconnected reasons and therefore do not receive X codings as extensions.

On the other hand, where one child's response is additional information and is directly related to the previous statement, it is considered as an extension of the thought and receives the X coding. The following example illustrates a series of extensions:

1)	C	Malobi took the money home with her.	CG	11
2)	T	What did Malobi do with the money?	TS	11X
3)	C	She saved it.	CG	11X
4)	C	She put it underground.	CG	11X
5)	C	She put sticks and tin over it.	CG	11X
6)	C	Before she did that, she put it in a little pot.	CG	11X
7)	T	Why do you suppose she buried it?	TS	61L
8)	C	So robbers couldn't find it and steal it.	CG	61L

In the above example, the children's responses on lines 2, 3, 4, and 5 and 6 all receive the X coding because they relate directly to one another by describing the chain of events that Malobi takes with the money. Line 7 represents the teacher's attempt to raise the level of thought from the informational level to the inference level and is coded L.

0 Unratable responses - statements that could not be interpreted or were not fully recorded received the unratable coding.

The complete coding for a thought unit is written in the following order:

Identifying coding
Thought level coding
Function coding

An example of the coding for one thought unit is as follows:

CG	61	X
Identifying coding	Thought level coding	Function coding

This coding indicates that the child gives (identifying coding) and inference within focus (thought level coding) which functions as an extension of thought (function coding). Each thought unit in the discussion is coded in similar manner.